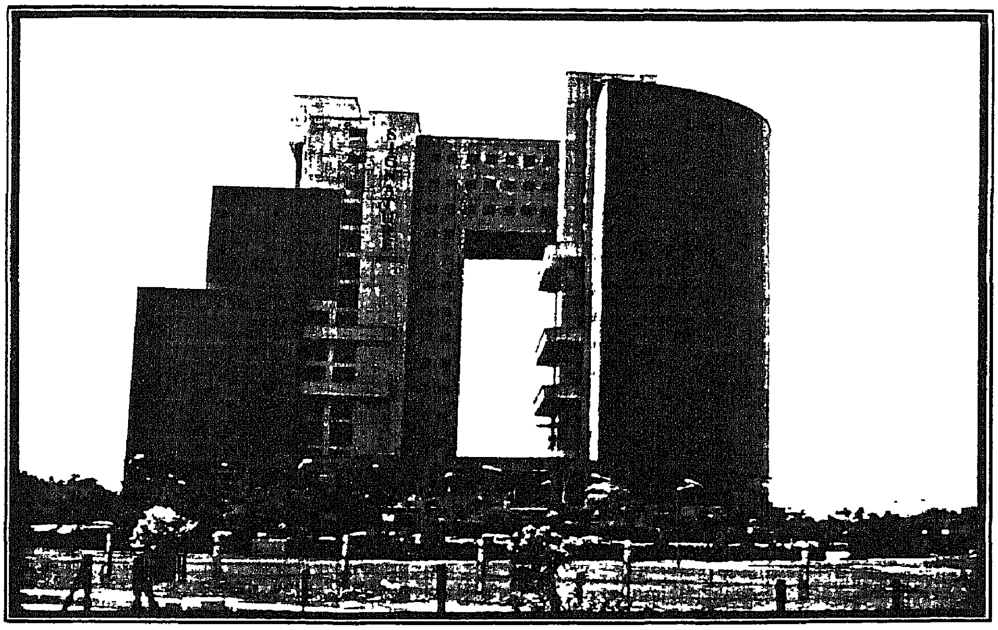
Energy Audit of Signature Tower, Gurgaon



Prepared for **UNITECH LIMITED, Gurgaon**

TERI Project Report No. 2001RT66

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Executive Summary

The Signature Tower building is one of the important buildings built by UNITECH LIMITED in Gurgaon. The building houses offices and showrooms of leading multinational and national companies. Building is quite new and at the time of energy audit was not fully occupied.

Buildings, which are constructed for such purposes are bound to provide excellent indoor conditions meeting all the national & international norms to the very sophisticated occupants. For creating a suitable environment they maintain required thermal, audio and visual comforts inside the building. These comforts are usually provided by electrical & mechanical systems and in return they consume energy. In recent past many buildings have been designed without giving adequate importance to the energy efficiency or esthetical aspects or functional aspects got more importance over energy efficiency. This led to the design of inefficient building envelope and ultimately resulted in over sizing of the electrical & mechanical systems. When these systems are operated at part or full load they waste energy. In last decades various studies, which were conducted on building design & their performances they reveal that there exists a potential to save substantial amount of energy in these buildings.

UNITECH LIMITED, which is working in generating awareness among the building developers & maintenance and operation people about energy efficiency and conservation in buildings, has taken various steps and building energy audit is just one of such step.

Energy audit is a systematic approach to identify energy waste in building operation and to determine how this waste can be eliminated within a reasonable time frame. The energy audit quantifies the energy use and identifies energy conservation opportunities with scope for energy and cost savings that are likely to be realised through investment in an energy conservation program and its outcome can be used for a prioritised action plan to conserve energy. Team comprising qualified professionals from Tata Energy Research Institute, New Delhi, India conducted the energy audit of the Signature Tower and major findings of the study are given below.

Major findings of the study

- The Signature Tower is a fifteen storey building with total built-up area of
- The building is open from 9:00 AM to 6:00 PM on weekdays but at many places occupants work for extended hours.
- The total height of the building is approximately 67 metres and the total built-up area is approximately 29103 m^2 or 3132621ft^2.
- The total conditioned area is approximately 253813 ft^2, which is around 81% of the total built-up area.
- The overall heat transfer coefficient or U value of the exterior wall is 0.35 btu/hr-ft^2-F.
- The U value of exposed roof is 0.112 btu/hr-ft^2-F.
- The glazing U value is 0.875 btu/hr-ft^2-F and shading coefficient is 0.26.
- Building is not connected to the grid. Five-DG sets are used to supply uninterrupted power supply to the building. Two DG sets are of 1250-KVA, two are of 1000-KVA and fifth one is of 380-KVA. HSD is being used as energy source for electricity generation in DG sets.
- The total connected load of external lighting is approximately 24.6 kW. The external lights are kept turned on from 7:00 PM to 5:00 AM in summer and 5:00 PM to 7:00 AM in winter months.
- Consumption in internal lighting and internal equipment along with fan input of air handling fans are billed separately and are not included as a part of this study.
- The central plant is capable of providing cooling up to 1250 TR and heating up to 600000 kcal/hr or 698 kW. Two vapour absorption machines of 425 TR each and one carrier centrifugal machine of 400 TR are used as the cooling source. VAM is also operated as heating source for building heating.
- The maximum winter demand with cooling is 832 kW and without cooling is 547 kW.
- Maximum summer demand is approximately 1268 kW.
- The estimated energy (HSD) consumption in winter months (from December to January or for 90 days) is 235536 litres.
- The estimated energy (HSD) consumption in summer, which extends from March to October for 275 days is 459975 lit.
- The estimated total annual energy consumption is approximately 1695511 litres of HSD.
- The estimated total annual energy cost is Rs 31994290 that correspond to 10.2 Rs/ft^2-month.

- AC system accounts for the maximum consumption, approximately 53%, indoor lighting & equipment load is not far behind and consumes about 44% of the total energy consumption, pumping takes only 2% and external lighting just 1% of the total energy consumed at Signature Tower.
- On load motor testing was done both in winter and summer to find out the operating efficiency of the motors.
- It has been found by motor on load test that motor are appropriately loaded and no undersizing is recommended.
- The average specific energy generation ratio (SEGR) of operating DG sets in summer and winter are 3.51 kWh/lit and 3.37 kWh/lit which are excellent.
- The operating specific power of centrifugal plant is 0.832kW/TR as against the rated specific power of 0.64 kW/TR. That means for producing one ton of cooling this plant is taking 0.192 kW extra or plant is operating at a lower efficiency than rated efficiency.
- The average operating specific power of VAMs is 0.505 kg of HSD/TR as against the rated specific power of 0.294. That means VAMs are taking approximately 0.211 kg of HSD extra for providing one ton of cooling.
- The VAM efficiency in heating mode is excellent.
- The average operating pump efficiency of 30 hp CHW pumps is approximately 64.5% as compared to rated efficiency of 76.2% which is quite adequate.
- The CDW pumps are operating at an average efficiency of 41.2% as compared to rated efficiency of 85%. The operating that means CDW pumps are operating at a low efficiency.
- The CDW pumps are delivering a discharge of 1100 gpm/pump at 32' head as compared to the rated flow of 950 gpm.
- Operating thermal efficiency of cooling tower is 71.2%, which is higher than the design efficiency.
- The average percentage of operating airflow (CFM) in AHUs is approximately 85% of the rated flow, which is extremely good.
- In winter the operating raw water pump efficiency was only 1.3% but in summer it was increased to 41.1%. This was happening due to unnecessary throttling of the pump. However it is still less than the rated efficiency which is 50%.
- There is hardly in improvement over pump's performance since winter. The operating efficiency of the pump is just 9.9% as compared to rated efficiency of 50%. This needs immediate attention.

- Operating pump efficiency shows an upward improvement. Now in summer it is 30.7% instead of just 12.5% in winter. However, it is still just half of the rated efficiency which is 61%.
- There is little improvement in summer pump efficiency as compared to winter efficiency and in fact it is better than the rated efficiency of 49%.
- No doubt the operating efficiency has increased from 6.8% in winter to 27.1% in summer of HVAC pump yet it is very less as compared to rated efficiency of 50%.
- By replacing inefficient pumps with inefficient pumps approximately Rs 128250 can be saved annually.
- By operating plants at rated efficiency there exists a potential to save 200997 lit of HSD annually. This will lead to the saving of approximately Rs 38 lakhs per year in energy cost.
- By enhancing operating pump efficiency of CDW pumps approximately 25025 lit of HSD can be saved annually. This would mean a cost saving of Rs 4.72 lakhs in energy cost annually.
- By keeping one cooling tower switched off during normal operation approximately 9308 litres or Rs 175640 can be saved annually.
- By operating external lighting at reduced voltage of 200V by installing energy saving device on external lighting panel Rs 106980 can be saved annually.
- By incorporating all the energy saving measures there is a potential to save approximately Rs 45.5 lakhs per year this would bring the cost index from 10.2 Rs/ft^2-mon to 8.75 Rs/ ft^2-mon.
- The major finding of this study is that using VAM for cooling is not a cost effective option since for producing one ton of cooling electric chiller takes only 0.64 kW while for producing one ton of cooling VAM consumes 0.346 lit of HSD. Since the SEGR of DG is approximately 3.5 kW/lit means using the same HSD (0.346 lit) 1.21 kW can be generated which can operate two electric chillers. Had electric chiller been operating in place of VAM how much difference that would be making is worked out and given below.

  The total cooling produced by VAM : 732650 ton-hrs
  The operating electric chiller efficiency : 0.832 kW/TR
  The energy consumed by electric chiller : 732659*0.832=609565 kWh
  The HSD consumption in DG sets : 609565/3.51=173655 lit
  Present consumption in VAM : 392700 lit
  Saving of HSD : 392700-173655=219045 lit

Saving in energy cost : 219045*18.87=Rs 4133380

This would bring down the energy cost index further from 8.85 Rs/ft^2-mon to 7.43 Rs/ft^2-mon.

1

Introduction

1.1 Background

Commercial buildings, which are designed and constructed for commercial purposes often, demanded to provide excellent comfortable environment to the occupants. For creating a suitable environment they maintain recommended thermal, audio and visual comforts inside the building. These comforts are usually provided by electrical & mechanical systems and in return they consume energy. It is basically the building developer responsibility to arrange security, maintenance and regular supply of energy to these buildings for their smooth functioning. In recent past many buildings have been designed without giving adequate importance to the energy efficiency or esthetical aspects or functional aspects got more importance over energy efficiency. This led to the over sizing of the electrical & mechanical systems. When these systems are operated at part load they waste energy. That leads to the additional cost of maintenance which is generally fixed and evaluated based on efficient functioning of the systems. In last decades various studies were conducted on building design & their performances and they reveal that there exists a potential to save substantial amount of energy in these buildings.

Keeping this in mind the UNITECH LIMITED management decided to find out whether energy utilization in their buildings is adequate or not. Whether there is any possibility to cut energy use or cost. In order to find out the suitable explanations of these queries a detailed energy audit that is qualitative in nature was planned. Tata Energy Research Institute, New Delhi pioneer in such activities has been assigned this task of conducting energy audit at Signature Tower, Gurgaon.

Energy audit is a systematic approach to identify energy waste in building operation and to determine how this waste can be eliminated within a reasonable time frame. The energy audit quantifies the energy use and identifies energy conservation opportunities with scope for energy and cost savings that are likely to be realised through investment in an energy conservation program and its outcome can be used for a prioritised action plan to conserve energy.

1.2 Sources of data & information used in the project

At the outset of this project for the collection of primary or desk top data a preliminary questionnaire was sent to the Signature Tower to collect some important but brief information about the energy data and system details. Immediately after this a detailed questionnaire with various formats was submitted to Signature Tower. Data collected from these exercises as well from the building drawings, equipment manuals, logbooks, and records have been used in conducting the study.

The secondary data was collected by a very detailed and comprehensive field survey, which was carried out in the months of February & August. Sophisticated and accurate instruments were used in collecting the data. Building load, operating equipment data and indoor thermal comfort conditions were measured and data were logged for 15 minute intervals. Various historical data, which was collected, were also verified during measurement.

1.3 Level of error margin in estimation of energy quantity & energy cost

During audit we were able to lay hands on HAVC contract manual. This contract had technical & financial specifications of installed HVAC system. Various design data, rated equipment data, thermo-physical properties of the building elements, outdoor and indoor design conditions and operating schedules were obtained from these specifications. Equipment cost and labour cost and other related cost for installing or retrofitting are generally defined in financial specifications. These specifications are very useful in redesigning a system and in estimating the retrofitting cost. Apart from this few data were also not available and it was told to the audit team by experience of the client. By using latest and accurate analytical tools it is felt that as far as the estimation in the projected savings in energy quantity and energy cost the projected figures are quite accurate or could vary in the range of –5 to +5%. However, it is also recommended that at the time when it will be finally decided to implement an energy conservation measure, actual quotation must be obtained from the supplier or manufacturer to estimate the implementation budget cost. Financial analysis should subsequently be modified and that should be taken as final figure to evaluate the economical attractiveness of the corresponding energy conservation measure.

.4 Acknowledgement

The members of the project team place on record their sincere thanks to Unitech Ltd. India with the task of conducting energy audit at Signature Tower, Gurgaon.

We are thankful to the officials of UNITECH LIMITED for their help & encouragement during field survey. We are indebted to Mr N K Datta, for their constant support by providing us the necessary building & system data, participating in field measurement and giving other relevant information and data.

We are also thankful to all maintenance staff for their support in field measurement and understanding the building automation system.

We wish to thank the officials of the Signature Tower who participated as team members during field survey at Signature Tower.

Our thanks are also for Mr G Gopalakrishnan for assistance in typing and applying the finishing touches to the report.

2

Building Description

2.1 Site description

Location

The Signature Tower is located on Delhi Jaipur highway in Gurgaon. The building is surrounded by other important building and quite near to the Gymkahan Club, Gurgaon.

Age of the building

The building is quite new and not even fully occupied.

Orientation & size

Signature Tower consists of two towers called tower A and tower B. Each tower is a fifteen-storey fully air-conditioned building with small parking basement. The longer axis of the building is oriented east west with entrance from north. Tower-A, which is on the left side of the entrance, is of rectangular shape and tower-B, which is on right side of the entrance lobby, is semicircular. The total height of the building is approximately 67 metres and the total built-up area is approximately 29103 m^2 or 3132621ft^2.

The floor-wise total built-up area is listed in table 2.1.

Table 2.1 Total built-up area

Floor level	Tower-A	Tower-B	Total
1	1937	905	2842
2	560	0	560
3	1168	905	2073
4	1168	905	2073
5	1168	905	2073
6	1168	905	2073
7	1168	905	2073
8	1168	905	2073
9	976	905	1881
10	976	905	1881
11	976	905	1881

12	976	905	1881
13	1008	905	1913
14	1008	905	1913
15	1008	905	1913
	16433	12670	29103

The total conditioned area is approximately 253813 ft^2, which is around 81% of the total built-up area.

Table 2.2 Floor-wise conditioned area of Tower-A & Tower-B

Floor No	Tower-A	Tower-B
1	3114	6452
2	4990	9357
3	10008	8647
4	9963	8177
5	9963	8177
6	9963	8177
7	9963	8177
8	9963	8177
9	7796	8177
10	7796	8177
11	7796	8177
12	7796	8177
13	9722	8680
14	7437	8680
15	7437	8680
Total	123706	124091

Table 2.3 Total conditioned area

	Conditioned area (ft^2)
Tower-A	123706
Tower-B	124091
Lobby	6017
Total	253813

Building elements

External wall is made up of 230-mm thick brick wall with both sides plastered with 12.5-mm cement plaster. No insulation in used in external wall. The overall heat transfer coefficient or U value is 0.35 btu/hr-ft^2-F.

Two types of partition wall are used. One is similar in construction as external wall but other one is half brick wall means 115-mm brick with both sides plastered with 12.5-mm cement plaster. The U values are 3.1 and 0.43 btu/hr-ft^2-F respectively.

Exposed roof has 115-mm thick RCC roof with inner side plastered with 12.5-mm cement plaster. The outer side of RCC roof is also plastered with 12.5-mm cement plaster and above cement plaster 40 mm PUF is provided as roof insulation. The U value of exposed roof is 0.112 btu/hr-ft^2-F.
The outer surface of the curtain wall is 6-mm tempered glass then a 90-mm air gap is provided between glass and 12-mm gypsum board layer. The glazing U value is 0.875 btu/hr-ft^2-F and shading coefficient is 0.26.
The

Building function

Signature tower houses many offices of multinational company as well their showrooms. It has also got a restaurant and kitchen at the ground floor.

Operating schedule

General starting time of the centre is 7:00 AM and general finish time is 7:00 however, late night sitting is not very uncommon thing. There are few call centres also which work round the clock. Few offices also work on Saturdays however, Sunday is observed as holiday in almost all the offices and show rooms.

2.2 Electrical supply

The signature tower is not yet connected to the grid and entire electricity demand is met through in house power generations. Five-DG sets are used to supply uninterrupted power supply to the building. Two DG sets are of 1250-KVA, two are of 1000-KVA and fifth one is of 380-KVA. HSD is being used as energy source for electricity generation in DG sets.

2.3 General lighting

Indoor lighting in Signature tower is managed by individual offices and there in no control of UNITECH on that and they are billed as per actual consumption. The electricity consumption in lighting is monitored on each floor and for each tower with the help of separate electronic meters.

External lighting that is managed by the UNITECH and not monitored and billed separately from each office. It is provided by 250-W high pressure sodium lamp (SON) mainly used for security lighting, 80-W high pressure mercury used in globe for façade lighting, 100-W incandescent lamps for street lighting and 70-W metal halide for landscape lighting. The total connected load is approximately 24.6 kW. The external lights are kept turned on from 7:00 PM to 5:00 AM in summer and 5:00 PM to 7:00 AM in winter months.

2.4 General equipment

The energy consumed in installed office equipment is metered separately and billed to each office. This was not included in the scope of energy audit.

2.5 Air-conditioning system

The space conditioning at Signature Tower is provided with the help of a central plant. The building is cooled in the summer and heated in the winter with the help of central plant. Simultaneous heating and cooling has also been observed during winter. Except for basement almost all the area both in tower A and Tower B along with lobby area at ground floor is air-conditioned. Building occupants seem to be very particular about maintaining a constant temperature and humidity during all period

Central HVAC plant details

The central plant consists of two Thermax Vapour Absorption Machines (VAM) and one Carrier centrifugal chiller. The rated cooling capacity of VAM is 425 TR and heating 300000 kcal/hr or 349 kW and the rated cooling capacity of Carrier plant is 400 TR. Hence the central plant is capable of providing cooling up to 1250 TR and heating up to 600000 kcal/hr or 698 kW. The chilled water system consists of two-loop primary and secondary system. A constant chilled water flow is maintained through plants with the help of three 20-hp pumps. However in distribution line chilled water flow varies with the varying building load and it is maintained with help of three 40-hp secondary chilled water pumps. Variable frequency drives are installed on two secondary water pumps and they are kept in auto mode while the third secondary water without frequency drive is operated in manual mode. The warm water in condenser line is circulated with the help of three 60-hp pumps. Three induced-draft cross flow cooling towers each of 490 TR capacity with two fans each of 15-hp are installed to cool warm water coming from plants' condensers. 31 air-handling units (AHUs) are installed to supply conditioned air to various are and the total capacity of the AHUs is approximately 1300 TR in summer, 1425 TR in monsoon and 930 kW in winter. During winter when building needs heating, hot water is circulated with the help of two 10-hp pumps.

3

Energy Consumption Pattern

3.1 Building electrical demand

Depending on the heating and cooling requirement of the building the operating electrical demand varies in summer and winter. During energy audit a very detailed and comprehensives monitoring of electrical load and at various panels and HSD consumption at various points were done. The collected data were thoroughly analysed and building energy consumption and its break-up were calculated and they are given in various sections below.

3.2 Winter electrical demand

Enercon power analyser was installed at various points and all electrical parameters were logged at 1-hour interval for one day. Based on the logged data the average hourly load on various panels was estimated and given in table 3.1 below.

Table3.1. Winter electrical demand in day time

S No	System	kW
1	Rising main-1	120
2	Rising main-2	61
3	Rising main-3	175
4	Rising main-4	109
5	Pumping load	47.52
6	Air blower	4.95
7	HVAC heating	29.1
8	HVAC cooling	284.7
	Total	831.27

Winter maximum electrical demand

1	With cooling	831.27	kW or	1039.1	KVA
2	Without cooling	546.57	kW or	683.21	KVA

3.3 Summer electrical demand

Table 3.2. System load demand in summer

S No	System	kW
1	Rising main-1	181
2	Rising main-2	78
3	Rising main-3	179
4	Rising main-4	109
5	Pumping load	35
6	Air blower	76
8	HVAC cooling	610
	Total	1268

The summer maximum electrical demand is 1268 kW as compared to winter demand of 831 kW.

3.4 Energy consumption

Signature Tower is yet not connected to grid hence it derives all its electrical energy through in house power generation. HSD is used as fuel both for power generation and in vapour absorption machines, which are used to generate chilled, and hot water for proving cooling and heating in the building. In the beginning flow meters were not installed to monitor total fuel consumption, fuel consumed in VAMs and DG sets separately. During summer audit it has been found that flow meters have been installed and daily consumption data were being recorded. These data were collected and based on that the total energy consumption and its break-up were calculated.

Table 3.3 Average daily electricity consumption in winter

Winter	DG-2 kWh	DG-4 kWh	DG-5 kWh	Total kWh
29/01/2002	324	6704	1634	8662
30/01/2002	2708	5636	1863	10207
31/01/2002	296	8148	1703	10147
01/02/2002	2936	5372	2297	10605
02/02/2002	2396	1508	5469	9373
03/02/2002	3464	5400	2005	10869
Average				9977

The average electricity consumption on a typical winter day = 9977 kWh

Assuming winter is of 90 days (December, January & February) and 75 days as working days

Electricity consumption on working day in winter : 748275 kWh

Electricity consumption on non-working days in winter : 5040 kWh

Total electricity consumption in winter months : 753315 kWh

HSD consumption for generating 753315 kWh : 223536 litres

HSD consumption in VAM for heating : 160 lit/day

HSD consumption in VAM in winter months : 12000 litres

Total energy (HSD) consumption in winter months : 235536 litres

Energy consumption in summer months

Table3.4 Monitored HSD consumption

Month	DG (lit)	VAM (lit)	Total (lit)
May	116215	34835	151050
June	120408	42350	162758
July	115235	66340	181575
August	125575	32085	157660
Total	477433	175610	653043
average daily	3882	1428	5309

Average daily HSD consumption : 5309 litres

Total energy (HSD) consumption in summer: 5309*275=1459975 lit

Total energy (HSD) consumption

Total annual consumption : 235536+1459975=1695511 litr

3.5 Energy cost

Present HSD rate : 18.87 Rs/lit

Total annual energy cost : 18.87*1695511= Rs 31994290

Total built-up area of the building : 3132621 ft^2

Energy cost/ ft^2-month : 31994290/3132621 = Rs 10.2

3.6 System-wise energy consumption & cost

Table 3.5 System-wise break-up of total energy consumption

S No.	System	HSD consumption (lit)	Cost (Rs)
1	AC system	911194	17194231
2	Indoor lighting & equipment	741009	13982840
3	External lighting	27777	524152
4	Pumping	15531	293070
	Total	1695511	31994293

As shown in figure 3.1 the AC system accounts for the maximum consumption, approximately 53%, indoor lighting & equipment load is not far behind and consumes about 44% of the total energy consumption, pumping takes only 2% and external lighting just 1% of the total energy consumed at Signature Tower.

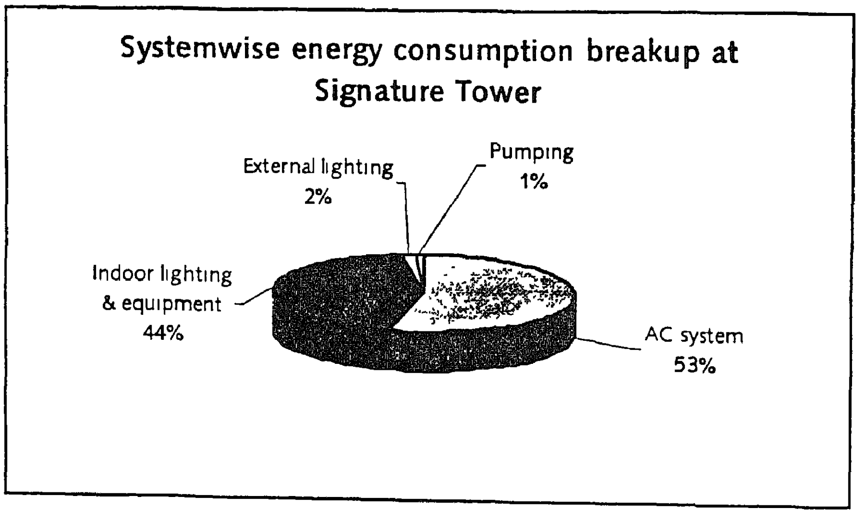

Figure 3.1

4

Electrical Systems

4.1 Winter measurement

Motor load test has been carried out on 36 motors in winter at Signature Tower, Gurgaon to find out their loading percentage and operating efficiency. Electrical parameters like voltage (V), current (I), power factor (PF), and input electrical energy (kW) were measured on each phase and they are listed in table 4.1.

Table 4.1 Operating electrical parameters of motors for Winter

S.No	Name of motor	V	I	PF	kW
1	AHU-1	404	8.27	0.61	1.17
		414	8.64	0.60	1.24
		412	8.42	0.66	1.32
2	AHU-30	402	10.19	0.74	1.76
		407	10.41	0.78	1.91
		410	10.25	0.72	1.76
3	AHU-28	404	6.81	0.47	0.75
		410	6.78	0.49	0.79
		410	6.83	0.47	0.75
4	AHU-26	400	12.60	0.81	2.40
		407	12.50	0.80	2.30
		412	12.47	0.78	2.30
5	AHU-24	404	6.93	0.49	0.79
		410	6.93	0.51	0.84
		410	7.03	0.48	0.80
6	AHU-22	407	7.28	0.56	0.96
		402	7.19	0.50	0.84
		412	7.33	0.51	0.89
7	AHU-20	404	7.00	0.56	0.92
		410	6.98	0.57	0.94
		410	7.07	0.56	0.93
8	AHU-18	400	13.90	0.85	2.70
		407	14.30	0.86	2.90
		412	14.30	0.83	2.80
9	AHU-16	404	7.76	0.52	0.95
		409	7.70	0.52	0.94
		409	7.53	0.51	0.79
10	AHU-14	400	15.60	0.73	2.60
		407	16.30	0.76	2.90
		412	16.50	0.73	2.80
11	AHU-8	405	6.92	0.50	0.81
		410	6.92	0.51	0.85
		414	7.16	0.50	0.85

12	AHU-4	402	7.90	0.47	0.75
		410	7.95	0.52	0.86
		414	7.11	0.48	0.82
13	AHU-31	402	13.50	0.59	1.90
		405	14.20	0.66	2.20
		410	14.50	0.58	2.00
14	AHU-29	398	13.90	0.84	2.70
		409	13.90	0.85	2.80
		412	14.00	0.82	2.70
15	AHU-27	400	10.92	0.80	2.02
		405	11.08	0.82	2.13
		412	10.69	0.76	1.90
16	AHU-25	397	7.18	0.38	0.63
		407	6.94	0.43	0.70
		414	7.27	0.37	0.65
17	AHU-23	398	12.30	0.77	2.20
		404	13.30	0.78	2.40
		410	13.20	0.75	2.30
18	AHU-19	398	18.60	0.85	3.60
		404	19.60	0.87	4.00
		410	19.50	0.85	3.90
19	AHU-17	398	15.70	0.82	2.90
		404	15.30	0.83	3.00
		410	15.80	0.81	3.00
20	AHU-13	397	14.80	0.82	2.80
		402	15.20	0.84	3.00
		410	15.10	0.80	2.90
21	AHU-11	400	7.02	0.55	0.89
		405	7.14	0.60	1.00
		412	7.34	0.56	0.98
22	AHU-9	400	7.62	0.62	1.08
		407	7.73	0.65	1.18
		412	7.89	0.62	1.15
23	AHU-5	402	7.48	0.54	0.94
		409	7.49	0.58	1.03
		412	7.35	0.53	0.93
24	Raw Water pump-1	404	10.99	0.87	2.20
		410	11.40	0.87	2.40
		412	11.80	0.86	2.40
25	Raw Water pump-2	404	10.68	0.86	2.14
		412	10.95	0.84	2.19
		410	10.92	0.86	2.24
26	Garden Water pump-1	404	7.89	0.79	1.46
		412	9.40	0.84	1.87
		412	10.24	0.79	1.94
27	Garden Water pump-2	404	10.10	0.66	1.56
		412	10.54	0.73	1.84
		412	11.53	0.70	1.92
28	Domestic Water pump-1	407	19.70	0.84	3.90
		416	20.90	0.86	4.30
		405	20.60	0.82	4.00
29	Domestic Water pump-2	409	18.90	0.83	3.70
		416	20.40	0.84	4.10
		416	20.00	0.79	3.80

30	HVAC pump-1	409	10.74	0.85	2.15
		416	11.38	0.85	2.30
		417	11.28	0.83	2.24
31	HVAC pump-2	409	11.06	0.88	2.30
		416	11.83	0.88	2.50
		416	11.61	0.85	2.40
32	Raw water domestic pump-1	404	13.00	0.87	2.60
		412	13.50	0.87	2.80
		410	13.50	0.85	2.70
33	Raw water domestic pump-2	404	12.40	0.87	2.50
		410	12.80	0.88	2.70
		410	12.80	0.85	2.60
34	HW circulation pump-2	410	18.80	0.88	3.90
		410	18.80	0.89	4.00
		410	18.40	0.88	3.80
35	CDW pump-1	410	100.10	0.86	20.40
		412	95.50	0.86	19.50
		412	94.40	0.86	19.40
36	CHW primary pump-3	410	29.40	0.84	5.80
		410	29.40	0.83	5.80
		412	29.40	0.83	5.80

Analysis

Based on the above data the % loading and operating efficiency of each motor has been calculated and listed in table 4.2 below.

Table 4.2 Motor loading and operating efficiency for Winter

S.No.	Name of Motor	Rated kW	Measured kW	% Loading	Operating Eff. (%)
1	AHU-1	5.5	3.73	59	82.0
2	AHU-30	7.5	5.43	63	85.0
3	AHU-28	3.0	2.29	64	81.0
4	AHU-26	7.5	7.00	81	86.0
5	AHU-24	3.0	2.43	68	81.6
6	AHU-22	3.0	2.69	75	83.0
7	AHU-20	3.0	2.79	78	83.0
8	AHU-18	7.5	8.40	97	86.8
9	AHU-16	4.0	2.68	56	79.0
10	AHU-14	11	8.30	67	87.0
11	AHU-8	4.0	2.51	53	78.0
12	AHU-4	3.0	2.43	68	81.6
13	AHU-31	11	6.10	49	86.0
14	AHU-29	7.5	8.20	95	86.6
15	AHU-27	7.5	6.05	70	85.6
16	AHU-25	3.7	1.98	45	76.0
17	AHU-23	9.3	6.90	65	87.0
18	AHU-19	9.3	11.50	109	88.0
19	AHU-17	9.3	8.90	84	88.0
20	AHU-13	9.3	8.70	82	88.0
21	AHU-11	3.7	2.87	65	81.0

22	AHU-9	3.7	3.41	77	83.0
23	AHU-5	4.0	2.90	61	80.0
24	Raw water pump-1	5.5	7.00	106	83.0
25	Raw water pump-2	5.5	6.57	99	83.0
26	Garden water pump-1	5.5	5.27	80	81.0
27	Garden water pump-2	5.5	5.32	80	81.0
28	Domestic water pump-1	15	12.2	73	89.0
29	Domestic water pump-2	15	11.6	69	88.5
30	HVAC pump-1	5.5	6.69	101	83.0
31	HVAC pump-2	5.5	7.20	109	83.0
32	Raw water domestic pump-1	11.0	8.10	65	87.0
33	Raw water domestic pump-2	11.0	7.80	62	86.5
34	HW circulation pump-2	7.5	11.70	136	87.0
35	CDW pump-1	55	59.3	101	93.5
36	CHW primary pump-3	15	17.4	104	90.0

4.2 Summer measurement

Motor load test has been carried out on 40 motors in summer at Signature Tower, Gurgaon to find out their loading percentage and operating efficiency. Electrical parameters like voltage (V), current (I), power factor (PF), and input electrical energy (kW) were measured on each phase and they are listed in table 4.3.

Table 4.3 Operating electrical parameters of motors for Summer

S.No	Name of motor	V	I	PF	kW
1	AHU-1	410	7.70	0.60	1.09
		419	8.07	0.60	1.18
		412	7.90	0.60	1.15
2	AHU-30	410	10.62	0.79	2.00
		410	11.02	0.77	2.00
		417	10.79	0.79	2.00
3	AHU-28	410	9.01	0.74	1.59
		416	9.20	0.75	1.66
		416	9.27	0.76	1.68
4	AHU-26	410	9.27	0.76	1.68
		416	9.20	0.75	1.66
		416	9.01	0.74	1.59
5	AHU-24	416	8.94	0.74	1.59
		414	9.33	0.75	1.68
		410	8.95	0.77	1.63
6	AHU-22	419	9.91	0.77	1.85
		410	10.43	0.79	1.95
		410	10.11	0.78	1.87
7	AHU-20	417	6.50	0.53	0.83
		416	6.48	0.52	0.82
		416	6.48	0.52	0.82
8	AHU-18	410	11.98	0.83	2.40
		414	11.45	0.84	2.30
		412	11.86	0.85	2.30

9	AHU-16	414	15.20	0.72	2.60
		409	14.70	0.69	2.40
		410	14.90	0.71	2.50
10	AHU-14	410	13.60	0.70	2.30
		409	13.34	0.78	2.20
		417	13.90	0.67	2.20
11	AHU-8	417	5.76	0.53	0.73
		416	5.66	0.52	0.72
		416	5.86	0.52	0.75
12	AHU-6	417	17.00	0.77	3.20
		409	16.80	0.77	3.00
		412	16.90	0.77	3.10
13	AHU-3	419	7.17	0.61	1.06
		409	7.59	0.60	1.07
		412	7.49	0.62	1.05
14	AHU-31	409	13.10	0.58	1.80
		417	13.40	0.57	1.80
		410	13.00	0.63	1.90
15	AHU-29	407	13.00	0.82	2.50
		421	12.22	0.82	2.40
		412	12.34	0.85	2.50
16	AHU-27	390	9.35	0.65	1.30
		390	9.36	0.64	1.30
		390	9.35	0.60	1.20
17	AHU-25	409	7.07	0.37	0.62
		414	6.87	0.44	0.72
		423	7.14	0.43	0.75
18	AHU-23	417	12.04	0.73	2.10
		409	11.28	0.73	1.93
		410	12.18	0.77	2.20
19	AHU-19	417	16.70	0.85	3.40
		409	17.40	0.85	3.50
		409	17.00	0.85	3.40
20	AHU-17	421	15.40	0.82	3.10
		407	15.00	0.82	2.90
		412	15.20	0.82	3.00
21	AHU-15	410	7.71	0.48	0.88
		419	7.21	0.50	0.86
		414	7.41	0.49	0.87
22	AHU-13	407	13.90	0.80	2.60
		407	13.85	0.80	2.50
		407	13.75	0.80	2.40
23	AHU-11	417	13.80	0.81	2.70
		409	13.60	0.80	2.60
		414	13.70	0.80	2.60
24	AHU-9	409	14.40	0.81	2.80
		412	14.50	0.84	2.90
		410	14.40	0.81	2.70
25	AHU-5	398	12.50	0.65	1.90
		390	12.40	0.65	1.80
		395	12.40	0.65	1.80
26	AHU-4	410	10.20	0.75	1.82
		421	10.16	0.78	1.92
		412	10.18	0.76	1.85

27	Raw water pump-1	417	7.35	0.70	1.24
		416	6.95	0.73	1.22
		412	6.84	0.72	1.18
28	Garden water pump-1	417	7.35	0.73	1.32
		416	7.20	0.77	1.33
		412	6.73	0.75	1.19
29	Domestic water pump-1	417	20.50	0.86	4.30
		416	20.70	0.88	4.40
		412	21.30	0.85	4.30
30	HVAC pump-1	417	12.02	0.87	2.50
		416	11.71	0.86	2.40
		412	11.95	0.86	2.40
31	Raw water domestic pump-1	417	12.60	0.86	2.60
		416	12.01	0.88	2.50
		412	11.85	0.87	2.40
32	CHW primary pump-3	407	25.1	0.84	5.00
		412	25.2	0.84	5.00
		410	25.3	0.84	5.00
33	CHW primary pump-2	407	24.5	0.84	4.80
		412	25.8	0.83	5.10
		410	25.5	0.82	4.95
34	CHW secondary pump-2	407	14.7	0.72	2.50
		412	15.8	0.71	2.70
		414	15.5	0.72	2.60
35	CDW pump-1	407	74.1	0.87	15.2
		412	71.1	0.86	14.6
		410	72.5	0.85	14.7
36	CDW pump-2	407	76.1	0.88	15.80
		412	79.2	0.89	16.80
		410	78.5	0.88	16.30
37	Cooling Tower-1	407	38.8	0.67	6.10
		412	40.2	0.66	6.40
		410	39.5	0.65	6.25
38	Cooling Tower-2	407	22.7	0.66	3.50
		412	24.3	0.67	3.70
		414	23.5	0.65	3.60
39	Cooling Tower-3	407	41.9	0.71	7.00
		412	42.3	0.71	7.20
		414	41.5	0.71	7.10
40	Secondary CHW pump-1	364	22.0	0.45	7.00

Analysis

Based on the above data the % loading and operating efficiency of each motor has been calculated and listed in table 4.4 below.

Table 4.4 Motor loading and operating efficiency for Summer

S.No.	Name of Motor	Rated kW	Measured kW	% Loading	Operating Eff. (%)
1	AHU-1	5.5	3.42	54	81.0
2	AHU-30	7.5	6.00	70	86.0
3	AHU-28	7.5	4.93	57	85.0

4	AHU-26	7.5	4 93	57	85.0
5	AHU-24	7.5	4.90	57	85.0
6	AHU-22	7.5	5.67	66	85.0
7	AHU-20	3.0	2.47	69	82.0
8	AHU-18	7.5	7.00	81	86.0
9	AHU-16	11.0	7.50	61	87.0
10	AHU-14	11.0	6.70	54	87.0
11	AHU-08	4.0	2.20	46	72.0
12	AHU-06	9.3	9.30	88	88.0
13	AHU-03	3.7	3.18	72	82.0
14	AHU-31	11.0	5.50	45	85.0
15	AHU-29	7.5	7.40	86	86.0
16	AHU-27	7.5	3.80	44	74.0
17	AHU-25	3.7	2.09	47	76.0
18	AHU-23	9.3	6.23	59	87.0
19	AHU-19	9.3	10.30	97	88.0
20	AHU-17	9.3	9.00	85	88.0
21	AHU-15	3.7	2.61	59	80.0
22	AHU-13	9.3	7.50	71	87.0
23	AHU-11	9.3	7.90	75	88.0
24	AHU-09	9.3	8.40	79	88.0
25	AHU-05	11.0	5.50	45	85.0
26	AHU-04	7.5	5.59	65	85.0
27	Raw water pump-1	5.5	3.64	55	79.0
28	Garden water pump-1	5.5	3.84	58	79.0
29	Domestic water pump-1	15.0	13.00	78	89.5
30	HVAC pump-1	5.5	7.30	110	83.0
31	Raw water domestic p-1	11.0	7.50	60	87.0
32	CHW primary pump-3	15.0	15.00	90	89.5
33	CHW primary pump-2	15.0	14.85	89	89.5
34	CHW secondary pump-2	30.0	7.80	23	72.0
35	CHW secondary pump-1	30.0	7.00	21	70.0
36	CDW pump-1	55.0	44.50	76	93.5
37	CDW pump-2	55.0	48.90	83	93.5
38	Cooling Tower-1	22.0	18.75	78	91.0
39	Cooling Tower-2	11.0	10.80	87	89.0
40	Cooling Tower-3	22.0	21.30	88	91.0

4.3 Observations and recommendations

For Winter

- The operating efficiencies of motors are excellent and the energy losses are within recommended limits.
- AHU-19 , Raw water pump-1, HVAC pump-1, HVAC pump-2, CDW pump-1, CHW primary pump-3, Hot water circulation pump-2 motors are observed to be operating in overloading conditions ranging from 101% to 136%.
- The power factor ranges from as low as 0.37 to as high as 0.89.
- The voltage ranges from 397 Volts to 417 Volts.

- There is no need to replace some under loaded motors as they have been operating on good efficiency like AHU-25 motor.

For Summer

- The operating efficiencies of motors are excellent and the energy losses are within recommended limits.
- There is no need to replace some under loaded motors as they have been operating on good efficiency like AHU-5 motor and AHU-8 motor.
- HVAC pump-1 motor is observed to be operating in overloading condition i.e. 110% loading.
- The voltage ranges from 364 Volts to 423 Volts.
- The power factor ranges from as low as 0.37 to as high as 0.89.

4.4 DG sets

Loading pattern of each operating DG sets were monitored both in winter and summer. Based on the recorded data specific energy generation ratio (SEGR) have been calculated and they are given below.

Winter DG Set monitoring

DG Set No-2 (1000 KVA)

Rated amps : 1392
Operating amps : 532

Table 4.5 Load & consumption monitoring of DG-2 in winter

Date	HSD (lit)	kWh	Run time (hrs)	SEGR
30/01/2002	100	324	0.5	3.24
31/01/2002	955	2708	7.05	2.84
01/02/2002	95	296	0.45	3.12
02/02/2002	1130	2936	7.25	2.60
04/02/2002	795	2396	10.15	3.01
05/02/2002	1010	3464	8.05	3.43
			average	**3.04**

DG Set No-4 (1250 KVA)

Rated amps : 1740
Operating amps : 924

Table 4.6 Load & consumption monitoring of DG-4 in winter

Date	HSD (lit)	kWh	Run time (hrs)	SEGR
30/01/2002	2080	6704	14.5	3.22
31/01/2002	1850	5636	10.35	3.05
01/02/2002	2500	8148	15.5	3.26
02/02/2002	1680	5372	7.5	3.20
04/02/2002	392	1508	2.35	3.85
05/02/2002	1638	5400	9.55	3.30
			average	**3.31**

DG Set No-5 (380 KVA)

Rated amps : 529 amps

Table 4.7 Load & consumption monitoring of DG-5 in winter

Date	HSD (lit)	kWh	Run time (hrs)	SEGR
30/01/2002	395	1634	7.15	4.14
31/01/2002	695	1863	8.15	2.68
01/02/2002	380	1703	7.45	4.48
02/02/2002	583	2297	10.05	3.94
04/02/2002	1522	5469	25.15	3.59
05/02/2002	528	2005	8.1	3.80
			average	**3.77**

The average SEGR of DG sets in winter is 3.37 kWh/litre.

Summer DG Set monitoring

DG Set No-1 (1250 KVA)

Rated amps : 1740

Operating amps : 1105

Table 4.8 Load & consumption monitoring of DG-1 in summer

Date	HSD (lit)	kWh	Run time (hrs)	SEGR
06/08/2002	2710	9670	16	3.57
07/08/2002	2624	9590	15.3	3.65
08/08/2002	2673	9520	15.3	3.56
09/08/2002	2874	9940	16	3.46
10/08/2002	2992	10210	21.5	3.41
12/08/2002	2626	9360	15.3	3.56
13/08/2002	2731	9730	16.5	3.56
14/08/2002	2857	9410	15.3	3.29
16/08/2002	2822	10220	16.5	3.62
17/08/2002	370	1250	2	3.38
			average	**3.51**

DG Set No-2 (1000 KVA)

Rated amps : 1392
Operating amps : 973

Table 4.9 Load & consumption monitoring of DG-2 in summer

Date	HSD (lit)	kWh	Run time (hrs)	SEGR
05/08/2002	790	2790	6.5	3.53
06/08/2002	845	2970	7.5	3.51
07/08/2002	923	3370	7.5	3.65
08/08/2002	112	370	1	3.30
09/08/2002	1998	7420	13	3.71
10/08/2002	934	3320	8.3	3.55
12/08/2002	908	3200	8.5	3.52
13/08/2002	901	3090	8.25	3.43
14/08/2002	830	2870	8.5	3.46
15/08/2002	606		7	
16/08/2002	912		7.75	
17/08/2002	1126		9 5	
18/08/2002	839		7	
			average	**3.52**

DG Set No-3 (1000 KVA)

Rated amps : 1392
Operating amps : 959

Table 4.10 Load & consumption monitoring of DG-3 in summer

Date	HSD (lit)	kWh	Run time (hrs)	SEGR
06/08/2002	2690	9310	17	3.46
08/08/2002	3634	12860	26	3.54
09/08/2002	980	3400	8	3.47
10/08/2002	1694	5900	13	3.48
11/08/2002	2078	6700	17.5	3.22
12/08/2002	2278	8500	15.3	3.73
13/08/2002	1961	7400	13	3.77
14/08/2002	2255	7800	14.5	3.46
15/08/2002	529	1700	5	3.21
16/08/2002	2230	8100	15	3.63
17/08/2002	1620	5700	12.5	3.52
18/08/2002	1959	6700	16	3.42
19/08/2002	3070	11000	20.75	3.58
			average	**3.50**

DG Set No-4 (1250 KVA)

Rated amps : 1740

Operating amps : 1115

Table 4.11 Load & consumption monitoring of DG-4 in summer

Date	HSD (lit)	kWh	Run time (hrs)	SEGR
15/08/2002	1268	3840	11.75	3.03
17/08/2002	1820	7070	13.5	3.88
18/08/2002	2834	10320	15.75	3.64
			average	3.52

The average operating SEGR of the DG Sets is 3.51 kWh/lit which is excellent and this reveals that DG sets are operating efficiently.

4.5 External lighting

External lighting includes mainly security lighting, façade lighting, landscape lighting, street lighting and decorative lighting in fountains etc. The type and number of lamps and their application are given in table 4.12 below.

Table 4.12 External lighting

S No	Lamp type	No. of lamps	Lamp wattage (W)	Ballast wattage (W)	Total wattage (W)	Connected load (kW)
1	High pressure sodium	62	250	30	280	17.36
2	High pressure mercury	15	80	20	100	1.5
3	Incandescent	34	100	0	100	3.4
4	Metal halide	33	70	0	70	2.31
					Total	24.57

Annual energy consumption in external lighting

In winter

Operating lighting load (kW) : 24.00

Daily operating hours : 14

No. of days : 90

Energy consumed (kWh) : 24*14*90=30240

In summer

Operating lighting load (kW) : 24.00

Daily operating hours : 10

No. of days : 275

Energy consumed (kWh) : 24*10*275=66000

Total energy consumed in external lighting (kWh): 30240+66000=96240

Annual energy cost for external lighting system

HSD consumption in external lighting in winter (lit): 30240/3.37=8973
HSD consumption in external lighting in summer (lit): 66000/3.51=18804

Total HSD consumption for external lighting (lit) : 8973+18804=27777

Total energy cost for external lighting (Rs) : 27777*18.87=524252

Energy saving option: Operate external lighting system at reduced voltage

By using suitable energy saving device (popularly known as P-20 and manufactured by Beblec, India limited) it is possible to operate the entire external lighting circuit at 200 Volts instead of 230 Volts. Device puts impedance across the circuit in such a manner to reduce the current. The device so carefully designed to ensure that any reduction in voltage does not impair the ability of the luminaire to strike. Device works very effectively and efficiently on all the discharge lamps and does not have any impact on the power factor. A conservative estimate shows that a saving of 20% can easily be achieved by using this device.

The load on external lighting circuit at 230 volts : 24.6 kW
Power factor on this circuit : 0.8
Operating load in KVA : 30.75

A device of 36 KVA capacity is recommended

Load after putting the device (20% reduction) : 19.68 kW
Reduction in kW : 4.92 kW
Total operating hours per year : 4010
Total energy saving potential (kWh) : 4010*4.92=19730
Total HSD saving in DG sets (lit) : 19730/3.48=5670
Annual saving in energy cost (Rs) : 106980
Initial cost of the device (Rs) : 47120
Payback period (months) : 47120/106980=6

5

HVAC Systems

The space conditioning at Signature Tower is provided with the help of a central plant. The building is cooled in the summer and heated and/or cooled in the winter. Simultaneous heating and cooling has also been observed during winter. Except for basement almost all the area both in tower A and Tower B along with lobby area at ground floor is air-conditioned. Building occupants seem to be very particular about maintaining a constant temperature and humidity during all period .

5.1 HVAC system consumption pattern

At Signature Tower, separate energy meter has been installed on the AC panel to record the electricity consumption in Ac plants, CHW pumps, CDW pumps and cooling towers. But that does not give the equipment-wise break-up of the consumption. Flow meters are also installed to record the fuel consumption in two VAMs. However these meters are not connected to building management systems therefore no ready records are also available but logbook data are being maintained. Based on recorded log book data, measured equipment parameters during field survey, and discussion made with the engineering and maintenance staff the energy consumed in HVAC system has been estimated and given in sections below.

Summer energy consumption

HSD consumption in VAM for cooling

HSD consumed in VAM for cooling is collected from logbook and based on that data following have been worked out.

Average daily consumption in VAM	:	1428 lit
Total number of summer days	:	275
Total consumption in VAM for cooling	:	275*1428=392700 lit

Average daily HSD consumption in DGs : 3882 lit
Average daily kWh consumption : 3882*3.51=13626 kWh
Daily consumption in rising main-1 : 1669 kWh
Daily consumption in rising main-2 : 1135 kWh
Daily consumption in rising main-3 : 2916 kWh
Daily consumption in rising main-4 : 1825 kWh
Daily consumption in external lighting : 240 kWh
Daily consumption in pumping : 212 kWh

Average daily consumption in
HVAC system : 13626-1669-1135-2916-1825-240-212=5629 kWh

Number of operating days in summer : 275 days
Total consumption in HVAC system in summer: 275*5629=1547975 kWh

Summer energy consumption

HSD consumption in VAM

Average daily HSD consumption when used for heating: 160 litres/day
Number of operating days in winter : 75
Total HSD consumption in VAM in winter : 75*160=12000 lit

Average daily HSD consumption in DGs : 2960.5 lit
Average daily kWh consumption : 2960.5*3.37=9977
Daily consumption in rising main-1 : 1825 kWh
Daily consumption in rising main-2 : 824 kWh
Daily consumption in rising main-3 : 2585 kWh
Daily consumption in rising main-4 : 1275 kWh
Daily consumption in external lighting : 336 kWh
Daily consumption in pumping : 190 kWh

Average daily consumption in
HVAC system : 9977-1825-824-2585-1275-336-190=2942 kWh

Number of operating days in winter : 75 days
Total consumption in HVAC system in winter: 75*2942=220650 kWh

Total annual energy consumption in HVAC system

Table 5.1. Total annual energy consumption in HVAC system

S No	Energy	kWh	HSD (lit)
1	Electricity in summer	1547975	441019
2	Electricity in winter	220650	65475
3	HSD used in VAM in summer		392700
4	HSD used in VAM in winter		12000
Total			911194

The total annual energy consumption in HVAC system is estimated to be 911194 litres of HSD, which is approximately 54% of the total energy consumed in the building.

5.2 Estimated energy cost of HVAC system operation

The annual energy consumption : 911194 lit
The annual energy cost : 911194*18.87= Rs 17194230

Approximately one crore seventy-one lakh ninety four thousand two hundred thirty rupees spent in the operation of HVAC system, which does not include air-handling units.

5.3 Projected energy consumption in HVAC system at full occupancy

In order to find out energy consumption in HVAC system when building gets fully occupied latest simulation technique has been adopted. HAP-4.05 which a commercial software and developed by carrier has been used. At first using the hourly weather file which includes the hourly temperature, relative humidity, rain fall, sun shine, wind velocity and solar radiation etc. the heat load of each AHU has been calculated and their comparison is given in table 5.2 below.

Table 5.2 Heat load comparison

AHU No	No	Rated TR	HAP TR
AH-1	1	22.77	18.8
AH-2	1	54.78	57.8
AH-3	1	40.24	32.9
AH-4	1	39.86	35.1
AH-5	1	54.8	47.9
AH-6	1	48.36	46.9
AH-7	1	42.88	41.1

AH-8	5	47.26	51.3
AH-9	8	39.54	41.8
AH-18	3	38.45	40
AH-24	1	38.78	40.2
AH-25	1	39.54	37.3
AH-26	1	51.95	50.9
AH-27	2	41.03	43.2
AH-28	1	33.62	34.3
AH-30	1	39.62	38.7
AH-31	1	48.53	47.7
	Total	1305.76	1326.8

As shown in table 5.4 the heat load calculation of HVAC consultant which was calculated by using carrier charts are matching with the loads which are calculated by using HAP-4.05 software.

Now by using the same software hourly load at each hour and in each month was calculated which is given in tables below.

Table 5.3A Average hourly plant load when whole building is occupied

Time	Jan	Feb	Mar	Apr	May	Jun
8:00	84	110	557	637	789	977
9:00	99	516	589	665	744	1038
10:00	567	594	651	671	897	1092
11:00	631	609	695	724	998	1133
12:00	612	653	670	892	1140	1223
13:00	632	655	713	962	1216	1217
14:00	648	669	740	968	1279	1268
15:00	665	502	764	1051	1223	1288
16:00	650	671	752	994	1293	1288
17:00	410	842	719	1052	1118	1242
18:00	361	638	580	879	1140	1327
19:00	619	370	657	812	1068	1140
20:00	253	610	695	722	952	1036

Table 5.3B Average hourly plant load when whole building is occupied

Hrs	Jul	Aug	Sep	Oct	Nov	Dec
8	1120	1064	869	611	218	66
9	1101	1083	949	417	578	95
10	1158	1130	990	759	630	153
11	1212	1111	1055	755	459	207
12	1203	1195	1082	765	562	283
13	1247	1198	1061	904	658	376
14	1289	1153	1077	962	707	425
15	1284	1222	1087	957	748	459
16	1299	1158	1086	969	733	456
17	1253	1190	1114	834	681	403

18	1259	1128	1070	799	613	618
19	1144	1081	1032	818	663	449
20	1102	1053	999	808	659	250

Now the total cooling produced in each month is calculated using the same software, which is given below.

Table 5.4 Total ton-hours in a year

Month	Ton-hrs/day	days	total ton-hrs
Jan	6230.5	25	155763
Feb	7437.6	25	185940
Mar	8782.7	28	245916
Apr	11027.3	26	286710
May	13856.5	28	387982
Jun	15268.2	26	396973
Jul	15669.5	28	438746
Aug	14764.6	28	413409
Sep	13469.6	26	350210
Oct	10356.1	28	289971
Nov	7908.6	26	205624
Dec	4241.1	25	106028
Total			3463269

As shown above the total cooling produced by the plants when entire building is occupied is 3463269 ton-hrs. This is to be produced by three plants. Based on monthly cooling produced plant loading is calculated and given in table below.

Table 5.5 Cooling produced by each plant

Month	Cooling produced by VAM-1 (ton-hrs)	Cooling produced by VAM-2 (ton-hrs)	Cooling produced by Centrifugal plant (ton-hr)
Jan	77881	0	77881
Feb	92970	0	92970
Mar	122958	0	122958
Apr	95570	95570	95570
May	129327	129327	129327
Jun	132324	132324	132324
Jul	146249	146249	146249
Aug	137803	137803	137803
Sep	116737	116737	116737
Oct	96657	96657	96657
Nov	102812	0	102812
Dec	0	0	106028
Total	1251288	854667	1357315

After calculating the amount of cooling each plant is supposed to be produced annually the energy consumed by each plant is estimated.

S No	Plant	Cooling produced (Ton-hrs)	Specific power	Energy consumed
1	VAM-1	1251288	0.35 lit/TR	437951 lit
2	VAM-2	854667	0.35 lit/TR	299133 lit
3	Centrifugal Plant	1357315	0.64 kW/TR	868682 lit or 250364 lit

Total projected energy consumption in plants for producing required amount of cooling is approximately 987448 lit.

Similarly the amount of energy to be consumed for producing required amount of heating is also estimated and that is given below.

Table 5.6 Energy consumption in plant for producing required heating

Month	Total heating required(MBH)	HSD required (Lit)
Nov	14049	555
Dec	82274	3252
Jan	81136	3207
Feb	35790	1415
Total	213249	8429

Total projected annual consumption in Plant when whole
building is occupied : 8429+987448=995877 lit/year

Present energy consumption when building is not
fully occupied : 607734 lit/year

It is difficult to find out the wastage since the projected consumption is given when whole building is occupied and the consumption data available is for partly occupied building.

For finding out the exact wastage the operating efficiency of each equipment is worked out and then compared with the rated efficiency. The detailed analysis is given in section below.

5.4 Observations and measurements

Chilling Plants

The operating parameters of both VAMs and centrifugal plants have been monitored each for one day in summer. The supply chilled water temperature (SCHWT), return chilled water temperature (RCHWT), entering condenser water temperature (ECDWT) and leaving condenser water temperature (LCDWT) were recorded in a data logger at 30 minutes interval. Similarly operating electrical parameters of compressors mainly voltage, current, power factor and kW were also logged for the same time when temperature data were logged. Fuel consumption was measured at tank, which are provided for VAMS. Later these data were down loaded on the computer with the help of specific software for the calculation of operating efficiencies of the plants.

The chilled water and condenser water flows were measured with the help of non-intrusive type flow meter near the chilled water and condenser water pumps. Based on the operating data collected, the specific power and the coefficient of performance of both the plants at operating load have been calculated. The complete details of chiller performance analysis are summarised in Tables below.

Centrifugal Plant

Table 5.7. Operating specific power of centrifugal plant

Date	Time	Return CHWT (°F)	Supply CHWT (°F)	Chilled water flow (Usgpm)	Cooling produced (TR)	Input compressor kW	Specific power (IKW/TR)
14/08/2002	11.00:00	53.4	46.5	846	243	205	0.843
14/08/2002	12.00:00	52.1	45	846	250	205	0.819
14/08/2002	13.00:00	51.4	44.4	846	247	204	0.827
14/08/2002	14:00.00	51	44.1	846	243	204	0.839

Average cooling produced by the centrifugal plant : 246 TR

Average consumption : 204.5 kW

Specific power (kW/TR) : 0.832

Rated specific power of centrifugal plant (kW/TR) : 0.64

This indicates that for producing one ton of cooling this plant is taking 0.192 kW extra or plant is operating at a lower efficiency than rated efficiency.

Table 5.8. Rated parameters of centrifugal plant

S No	Parameters	Value
1	Rated capacity	400 TR
2	Compressor motor rating	256 kW
3	Specific power	0.64 kW/TR
4	Design return chilled water temperature	54 °F
5	Design supply chilled water temperature	44 °F
4	Chilled water flow	959 USgpm
	Entering condenser water temperature	97.5 °F
	Leaving condenser water temperature	90 °F
5	Condenser water flow	1628 U gpm
6	100% load	256 kW
	70% load	176 kW
	50% load	136 kW
	25% load	86 kW

Vapour absorption machines (VAM)

VAM no-1

Table 5.9 Operating specific power of VAM no-1 in cooling mode

Date	Time	Return CHW T (°F)	Supply CHW T (°F)	Chilled water flow (Usgpm)	Cooling produced (TR)
23/08/2002	11:30:00	60.2	52.0	820	278
23/08/2002	12:00:00	60.6	52.5	820	273
23/08/2002	12:30:00	59.7	51.6	820	278
23/08/2002	13:00·00	60.6	52.6	820	273
23/08/2002	13:30:00	59.8	51.5	820	285
23/08/2002	14.00:00	59.8	51.5	820	282
23/08/2002	14:30:00	59.4	52.4	820	240
23/08/2002	15:00:00	60.0	52.6	820	254
23/08/2002	15:30:00	58.9	51.8	820	241
23/08/2002	16:00:00	60.7	52.6	820	275

Average cooling produced by the plant	:	268 TR
Fuel consumed	:	144 lit/hr or 122.4 kg/hr
Specific power	:	0.467 kg/TR
Rated specific power	:	0.294 kg/TR

The VAM-1 is taking 0.173 kg extra fuel (HSD) for producing each ton of cooling or plant is operating at a lower efficiency than its rated efficiency.

VAM no-2

Table 5.10. Operating specific power of VAM no-2 in cooling mode

Date	Time	Return CHW T (°F)	Supply CHW T (°F)	Chilled water flow (Usgpm)	Cooling produced (TR)
19/08/2002	11.30.00	59.6	52.8	820	234
19/08/2002	12:00:00	59.4	52.3	820	243
19/08/2002	12:30:00	59.2	52.2	820	238
19/08/2002	13:00:00	59.1	52.0	820	243
19/08/2002	13.30:00	59.0	51.7	820	248
19/08/2002	14:00:00	58.9	51.2	820	262
19/08/2002	14.30:00	58.7	51.6	820	243
19/08/2002	15:00:00	59.1	53.3	820	197
19/08/2002	15:30:00	59.0	52.6	820	222
19/08/2002	16:00:00	58.9	52.0	820	237
19/08/2002	16:30.00	58.8	51.7	820	240
19/08/2002	17:00:00	58.7	51.8	820	236

Average cooling produced by the plant : 236 TR

Fuel consumed : 126 lit/hr or 107 kg/hr

Specific power : 0.543 kg/TR

Rated specific power : 0.294 kg/TR

The VAM-2 is taking 0.249 kg extra fuel (HSD) for producing each ton of cooling or plant is operating at a lower efficiency than its rated efficiency.

Table 5.11. Rated parameters of VAM in cooling mode

S No	Parameters	Value
1	Rated capacity	425 TR
2	Oil flow rate	125 kg/hr
3	Design return chilled water temperature	54 °F
4	Design supply chilled water temperature	44 °F
5	Chilled water flow	1030 USgpm
6	Entering condenser water temperature	97.5 °F
7	Leaving condenser water temperature	90 °F
8	Condenser water flow	1870 USgpm
9	100% load	125 kg/hr
	70% load	98 kg/hr
	50% load	75 kg/hr
	25% load	41 kg/hr

Table 5.12 Operating parameter of VAM in heating mode

Date	Time	Supply hot water temperature (°F)	Return hot water temperature (°F)	Temperature rise (°F)
14/02/2002	12.20:00	105.1	102.9	2.2
14/02/2002	12:25:00	104.9	102.6	2.3
14/02/2002	12:35:00	105.1	102.7	2.3
14/02/2002	12:40:00	104.9	102.4	2.5
14/02/2002	12:50:00	104.7	102.4	2.3
14/02/2002	12:55:00	105.1	102.1	3.0
14/02/2002	13:10:00	105.1	102.7	2.3
14/02/2002	13.15:00	104.9	102.4	2.5
14/02/2002	13:25:00	104.7	102.2	2.5
14/02/2002	13:30:00	105.1	102.2	2.9
				2.5

Water flow rate : 917 Usgpm

Heat absorbed by water : 500*2.5*917 = 1146250 Btu/hr

Total operating time of VAM in one hour : 29 minutes

Total consumption of HSD : 40 litres or 34 kg

Specific energy ratio : 8495 kcal/kg

Rated specific energy ration : 7500 kcal/kg

Operating efficiency is better than the rated efficiency means plant is operating at excellent efficiency in heating mode.

Table 5.13. Rated parameters of VAM in heating mode

S No	Parameters	Value
1	Rated capacity	300000 kcal/hr
2	Oil flow rate	40 kg/hr
3	Design return chilled water temperature	128 °F
4	Design supply chilled water temperature	131 °F
5	Chilled water flow	1030 USgpm
6	100% load	40 kg/hr
	70% load	31 kg/hr
	50% load	24 kg/hr
	25% load	13 kg/hr

The operating and rated specific power consumption of each plant is given below:

Table 5.14. Operating and rated efficiency of the plants

Plant No	Average operating specific power	Rated specific power at full load
Centrifugal Plant	0.832 kW/TR	0.64 kW/TR
VAM no-1 (in cooling mode)	0.467 kg/TR	0.294 kg/TR
VAM no-2 (in cooling mode)	0.543 kg/TR	0.294 kg/TR
VAM no-1 (in heating mode)	8495 kcal/kg	7500 kcal/kg

CHW pumps and CDW pumps

The measured operating parameters of the CHW pumps and CDW pumps and complete analysis of pump performance evaluation are given in table 4.4 and table 4.5. The operating heads of CHW pumps and CDW pumps were measured with the help of digital pressure differential meters. Operating pump motor input was also measured with the help of power multi-meter. Flows were measured with the help of a non-intrusive type flow meter.

Chilled water primary pumps

Table 5.15. Operating efficiencies of CHW primary pumps

S No	Parameter	CHW primary pump no-2	CHW primary pump no-3
1	Discharge pressure (psig)	115	115
2	Suction pressure (psig)	90	90
3	Operating pump head (ft)	58	58
4	Water flow rate (Usgpm)	846	820
5	Pump input (kW)	13.4	13.3
6	Operating pump efficiency (%)	68.6	67

Table 5.16 Rated parameters of CHW primary pumps

S No.	Parameters	Rated value
1	Manufacturer	Beacon/Kirloskar
2	Model	UP-125-30A/SDB-125/150
3	Head (Ft of W)	39.4
4	Capacity (USgpm)	1029
5	Pump efficiency (%)	80
6	Motor hp	20

The average operating pump efficiency of 20 hp CHW pumps is approximately 64.5% as compared to rated efficiency of 76.2% which is quite adequate.

The 20-hp primary pumps are delivering an average 833 gpm per pump at 58' head.

The operating efficiency of secondary chilled water pumps could not be measured since no pressure gauges were installed on the pumps. Only input energy was measured in given in electrical systems chapter.

Condenser water pumps

Table 5.17. Operating efficiencies of CDW pumps

S No	Parameter	CDW pump no-1	CDW pump no-2
1	Discharge pressure (psig)	38.9	38.9
2	Suction pressure (psig)	0	0
3	Operating pump head (ft)	90	90
4	Water flow rate (Usgpm)	1370	1410
5	Pump input (kW)	41.6	45.7
6	Operating pump efficiency (%)	55.7	52.2

Table 5.18. Rated of CDW pumps

S No.	Parameters	Rated value
1	Manufacturer	Beacon/Kirloskar
2	Model	UP-200-30/SDA-200/200
3	Head (Ft of W)	82
4	Capacity (USgpm)	1959
5	Pump efficiency (%)	85
6	Motor hp	60

The CDW pumps are operating at an average efficiency of 43.65% as compared to rated efficiency of 69% of new generation pumps that is extremely low.

The CDW pumps are delivering a discharge of 1390 gpm/pump at 90' head as compared to the rated flow of 1959 gpm.

Cooling tower performance analysis

Different measurements taken on the cooling towers are given in Table 4.6. The average cooling towers wet bulb approach that is defined as the difference of leaving water temperature and the ambient wet bulb temperature, was found to be of 4°F which is extremely good (A wet bulb approach below 5°F is considered good). The average thermal efficiency of cooling towers has been calculated as 54% which is quite close to the design cooling tower thermal efficiency which is around 46%.

Table 5.19. Performance analysis of Cooling Towers

S No	Parameters	CT No-1	CT No-2	CT No-3
1	Fan dia (ft)	8	8	8
2	Total area (ft^2)	100.48	50.24	100.48
3	Air velocity (ft/min)	1390	1271	1226
4	Air flow (CFM)	139667	63855	123188
5	Leaving air DBT (° F)	86.7	87.4	87.1
6	Leaving air WBT (° F)	84.5	84.5	84.5
7	Enthalpy of leaving air (Btu/lb)	48.657	48.649	48.652
8	Entering air DBT (° F)	88.8	88.8	88.8
9	Entering air WBT (° F)	80.6	80.6	80.6
10	Entering air enthalpy (Btu/lb)	44.125	44.125	44.125
11	Heat rejected (Btu/hr)	2848373	1299961	2509534
12	Entering water temperature (° F)	86.5	86.5	86.5
13	Leaving water temperature (° F)	82.7	81.8	82.4
14	Thermal efficiency (%)	64.4	79.7	69.5
15	Wet bulb approach (° F)	2.1	1.2	1.8

Air Handling Units (AHUs) performance analysis

There are approximately 31AHUs of different capacity are installed in the Signature Tower. Measurement was carried out on almost all the operating AHUs. Total filter area was measured and the air velocity near filter in individual AHUs was measured with the help of digital air flow meter. The supply and return air dry-bulb and wet bulb temperatures were also measured to estimate the load on individual AHUs. Simultaneously electrical parameters of AHUs' motors were also measured with the help of digital power multimeter. The detailed AHUs analysis is given in tables below.

Table 5.20A AHUs coil capacity

S No	Parameter	AH-1	AH-3	AH-6	AH-8	AH-14	AH-16
1	Fan speed	High	Low	High	Low	High	High
2	Filter area (ft^2)	23.1	35.4	46.3	46.3	46.3	46.3
3	Air velocity (ft/min)	319	213	549	221	447	473
4	Air quantity (ft^3/min)	7379	7537	25398	10224	20679	21882
5	Return air DBT (° F)	76.8	80.8	74.1	71.6	73.1	73.6
6	Return air WBT (° F)	62.8	66.6	60.8	65.1	58	57.9
7	Return air enthalpy (Btu/lb)	28.236	31.139	26.843	29.991	26.162	26.373
8	Supply air DBT (° F)	62.6	71.1	62.2	65.1	63	61.7
9	Supply air WBT (° F)	58.1	59.2	58.2	60.3	58.1	58
10	Supply air enthalpy (Btu/lb)	25.043	24.716	25.111	26.369	25.04	25.048
11	Coil cooling capacity (TR)	8.8	15.3	16.5	13.9	8.7	10.9
12	Operating motor kW	3.42	3.18	9.3	2.2	6.7	7.5

Table 5.20B. AHUs coil capacity

S No	Parameter	AH-18	AH-20	AH-22	AH-24	AH-26	AH-28
1	Fan speed	High	Low	High	High	High	Low
2	Filter area (ft^2)	40.2	40.2	40.2	40.2	32.9	32.9
3	Air velocity (ft/min)	500	279	422	439	447	431
4	Air quantity (ft^3/min)	20093	11212	16959	17642	14691	14166
5	Return air DBT (° F)	74.5	73.6	74.7	76.6	79	79.3
6	Return air WBT (° F)	61.1	60.6	59.4	62.2	61.7	63.3
7	Return air enthalpy (Btu/lb)	27.044	26.743	26.932	27.819	29.782	28.59
8	Supply air DBT (° F)	61.8	61.6	64.8	62.2	62.8	66
9	Supply air WBT (° F)	58.2	58.1	58.1	58	60	60
10	Supply air enthalpy (Btu/lb)	25.048	25.049	25.03	25.045	26.384	26.636
11	Coil cooling capacity (TR)	15	7.1	12.1	18.4	18.7	11.8
12	Operating motor kW	7	2.47	5.67	4.9	4.93	4.93

Table 5.20C. AHUs coil capacity

S No	Parameter	AH-30	AH-5	AH-9	AH-11	AH-13	AH-15
1	Fan speed	Low	High	High	High	High	Low
2	Filter area (ft^2)	40.2	46.3	35.4	35.4	35.4	35.4
3	Air velocity (ft/min)	459	482	447	485	478	240
4	Air quantity (ft^3/min)	18446	22298	15817	17162	16914	8493
5	Return air DBT (° F)	75.8	74.8	73	73.9	73.4	81.3
6	Return air WBT (° F)	65.7	59.6	63.2	64.1	63.2	65.5
7	Return air enthalpy (Btu/lb)	27.521	27.028	28.616	29.242	28.613	30.239
8	Supply air DBT (° F)	61.3	61.7	63.5	64.1	63.9	60.1
9	Supply air WBT (° F)	59	58	60	60	60.1	58
10	Supply air enthalpy (Btu/lb)	25.715	25.048	26.379	26.376	26.376	25.058
11	Coil cooling capacity (TR)	12.5	16.6	13.3	18.4	14.2	16.5
12	Operating motor kW	6	5.5	8.4	7 9	7.5	2.61

Table 5.20D. AHUs coil capacity

S No	Parameter	AH-17	AH-19	AH-23	AH-25	AH-27	AH-29
1	Fan speed	High	High	High	Low	High	High
2	Filter area (ft^2)	35.4	46.3	46.3	40.2	46.3	46.3
3	Air velocity (ft/min)	463	512	471	227	414	546
4	Air quantity (ft^3/min)	16384	23686	21790	9122	19153	25259
5	Return air DBT (° F)	74.7	74.8	76.3	75	75.2	76.1
6	Return air WBT (° F)	65	60.1	66.5	66.1	65.8	61.7
7	Return air enthalpy (Btu/lb)	29.898	27.008	31.045	30.755	30.559	27.498
8	Supply air DBT (° F)	62.6	62.2	62.1	60.8	61.3	62.4
9	Supply air WBT (° F)	60	58	60	58.1	58.2	58
10	Supply air enthalpy (Btu/lb)	26.385	25.045	26.388	25.054	25.052	25.044
11	Coil cooling capacity (TR)	21.6	17.4	38.1	19.5	29.6	23 2
12	Operating motor kW	9	10.3	6.23	2.09	3.8	7.4

Table 5.20E. AHUs coil capacity

S No	Parameter	AH-31
1	Fan speed	High
2	Filter area (ft^2)	46.3
3	Air velocity (ft/min)	424
4	Air quantity (ft^3/min)	19615
5	Return air DBT (° F)	76.1
6	Return air WBT (° F)	61.1
7	Return air enthalpy (Btu/lb)	27.476
8	Supply air DBT (° F)	61.7
9	Supply air WBT (° F)	58.1
10	Supply air enthalpy (Btu/lb)	25.048
11	Coil cooling capacity (TR)	17.9
12	Operating motor kW	5.5

Operating and rated airflow of AHUs are given in table 5.21 below:

Table 5.21. Rated and operating CFM

S. No.	AHUs	Operating CFM	Rated CFM
1	AH-1	7379	10647
2	AH-3	7537	10383
3	AH-6	25398	24213
4	AH-8	10224	11853
5	AH-14	16053	23706
6	AH-16	21882	24294
7	AH-18	20093	19995
8	AH-20	7193	9548
9	AH-22	16959	19095
10	AH-24	13623	19050
11	AH-26	14691	20177
12	AH-28	14166	16588
13	AH-30	18446	20353
14	AH-5	13046	26765
15	AH-9	15817	21295
16	AH-11	17162	21295
17	AH-13	16914	21295
18	AH-15	8493	10648
19	AH-17	16384	21295
20	AH-19	23686	21647
21	AH-23	21790	21647
22	AH-25	9122	10118
23	AH-27	19153	20177
24	AH-29	25259	20177
25	AH-31	19615	24883
Total		400085	471142

The average percentage of operating airflow (CFM) in AHUs is approximately 85% of the rated flow, which is extremely good.

5.5 Energy conservation opportunities

Option1: Stop wastage of energy by enhancing the low operating efficiency of the cooling plants

As indicated in earlier section that the operating efficiency of both VAM (when used in cooling mode) and centrifugal machines are low as compared to their rated efficiency. While operating at low efficiency they waste substantial amount of energy. This wastage of energy as well as money could be stopped if the operating efficiency of the plants is maintained close to their rated efficiency. The amount of energy these plants are wasting every year has been estimated and given below.

Saving potential in VAM

1. Average daily operating hrs of VAM : 11 hrs
2. Total number of days in a year for cooling : 275 days
3. Total operating hours of VAM in a year : 11*275=3025 hrs
4. Total energy consumed in VAM for cooling : 392700 lit
5. Average operating efficiency of VAM : 0.536 lit/TR
6. Total cooling produced by VAM in a year :
   392700/0.536=732650 ton-hrs
7. Rated efficiency of VAM for cooling : 0.312 lit/TR
8. Estimated energy consumption with rated VAM efficiency :
   732650*0.312=228587 lit
9. Total energy saving potential in VAM : 392700-228587=164113 lit
10. Total energy in energy cost : 164113*18.87=Rs 3096810

Saving potential in Centrifugal Plant

1. Average daily operating hrs of centrifugal plant : 10 hrs
2. Total number of days in a year for cooling : 275 days
3. Total operating hours of plant in a year : 10*275=2750 hrs

4. Average daily consumption in plant : 2040 kWh
5. Total annual energy consumption in plant: 2040*275=561000 kWh
6. Average operating efficiency of plant : 0.832 kW/TR
7. Total cooling produced by plant in a year: 561000/0.832=674279 ton-hrs
8. Rated efficiency of centrifugal plant : 0.64 kW/TR
9. Estimated energy consumption with rated plant efficiency : 674279*0.64=431538 kWh
10. Annual energy saving potential in plant : 561000-431538=129462 kWh
11. Annual saving of HSD : 129462/3.51=36884 lit
12. Annual saving in energy cost : 36884*18.87=Rs 696000

Total annual energy saving potential : 164113+36884=200997 lit
Total annual saving in energy cost : 3096810+696000=Rs3792810

☞ By operating plants at rated efficiency there exists a potential to save 200997 lit of HSD annually. This will lead to the saving of approximately Rs 38 lakhs per year in energy cost.

Option2: Operate condenser water pumps at their rated efficiency

The average operating efficiency of the condenser water pumps is around 54% however, the rated efficiency is 85%. It is therefore recommended to operate the pumps by correcting operating parameters and that would lead to the substantial energy saving. The estimated energy and cost saving potential have been worked out and given in table below.

Table 5.22. Energy saving potential in CDW pumps

S No	Parameters	Value
1	Average operating load of pumps (kW/hr)	46.8
2	Total operating hrs/yr	5775
3	Total energy consumption (kWh/yr)	270270
4	Average operating efficiency	0.54
7	Rated efficiency of the pump	0.8
8	Modified load on pump at reated efficiency (kW)	31.59
9	Modified consumption in pump (kWh/yr)	182432
10	Energy saving potential (kWh/yr)	87838
11	Energy saving potential (Lit of HSD)	25025
12	Cost saving (Rs)	472222

- By enhancing operating pump efficiency of CDW pumps approximately 25025 lit of HSD can be saved annually. This would mean a cost saving of Rs 4.72 lakhs in energy cost annually.

Option 3: Switch-off one cooling tower fan

During normal operation throughout the summer, generally one VAM and one centrifugal plant operate for almost 10 to 11 hours a day. Along with these plants two-condenser water pumps and all the three cooling towers also kept on. During energy audit it has been observed that the leaving cooling tower temperature was maintained around 82.4 o F which is quite low as compared to the design temperature of 90 o F. Even ARI recommends only 85 o F. This suggests unnecessary over cooling of condenser water at cooling tower. It is felt that instead of three only two cooling towers would be sufficient to provide the required cooling and maintain water temperature at recommended value. Therefor it is recommended to operate two cooling towers with both the fans on in each cooling tower, to maintain same outlet cooling water temperature. If water spilling takes place then run all the three cooling towers with one fan in two cooling towers and in one cooling tower both the fans can be turned on.

Power consumption of one cooling tower fan	:	10.8 kW
Number of hours CT fan can be switched off	:	3025 per year
Annual electricity savings	:	32670 kWh
Annual HSD savings	:	9308 lit
Annual cost savings	:	Rs 175640
Investment required	:	Nil
Simple payback period	:	Immediate

Option 4: Correct chilled water primary & secondary loops

During energy audit it has been observed that in chilled water loop system, the common pipe length was more what is recommended. Apart from a control valve has also been installed which is again not recommended. During operation maintenance staff somehow got this impression that there is a back flow through this common pipe and then the control valve has been closed. This led to the operation of primary pumps and secondary pumps in series. When two plants operate primary pumps operate at maximum loading and when only one plant operates and only one primary pump operates it gets over loaded because it has to operate along with secondary pump in series. This has to be corrected. If possible the length of the common pip should be reduced, the control valve should be removed. This would lead to the correct operation of chilled water line and may reduce pumping cost and may help in enhancing operating plant efficiency.

6

Pumping Systems

Pumping is required mainly in domestic water distribution system, water treatment system, irrigation system and supplying make up water to main energy systems e.g. HVAC system. Pumps also consume energy no doubt not as much as consumed in HVAC system and lighting system but in most of the building not much importance is given to pumping that is why they operate at a very low efficiency and waste considerable amount of energy. Keeping this in mind a comprehensive study was done at Signature Tower of pumping system. Measurement was carried out both in winter and summer. The operating parameters of all the pumps in pumping systems were measured. Heads were measured with the help of digital pressure meter, flows with the help of non-intrusive type flow meters. Electrical parameters were also measured along with flow and head measurements.

The collected data were used to analyse the operating efficiencies of the various pumps. Detailed calculations are given tables below.

6.1 Energy consumed in pumping system

The pumps which are included in pumping systems are, raw water pumps, raw water domestic pumps, garden water pumps, domestic water pumps and HVAC pumps which are used to supply make water to the HVAC system. Operating electrical parameters were measured both in summer and winter and by multiplying that with operating hours of pumps the consumption has been estimated.

Table 6.1 Operating pumping load in winter

S No	Pump	No-1	No-2	Average
1	Raw water pump	7	6.57	6.8
2	Raw water domestic pump	8.1	7.8	8.0
3	Garden water pump	5.27	5.23	5.3
4	Domestic water pump	12.2	11.6	11.9
5	HVAC pump	6.69	7.2	6.9
average		39.26	38.4	38.8

The hourly operating load of pumping system in winter : 38.8 kW
The operating hours in winter : 4 hours/day

No. of days in winter : 75 days

Energy consumption in winter : 38.8*4*75 = 11640 kWh

Table 6.2 Operating pumping load in summer

S No	List of pump	kW
1	Raw water pump	3.64
2	Raw water domestic pump	7.5
3	Garden water pump	3.84
4	Domestic water pump	13
5	HVAC pump	7.3
average		35.28

The hourly operating load in summer : 35.28 kW

The operating hours in summer : 6 hours/day

No. of operating days in summer : 250 days

Energy consumption in winter : 35.28*6*250 = 52920 kWh

Total energy consumed in pumping system : 11640+52920=64560 kWh

6.3 Annual energy cost for running pumps

HSD consumed in winter (lit) : 11640/3.37 =3454

HSD consumed in summer (lit) : 52920/3.51=15077

Total HSD consumption (lit) : 3454+15077=15531

Annual energy cost (Rs) : 15531*18.87=349680

6.4 Operating pump efficiencies

Suction pressure & discharge pressure of each pump was measured with the help of digital pressure differential meter. Water flow was measured with the help of non-intrusive flow meters. Simultaneously the operating input kW of pump motor was also measured. These data were subsequently analysed to calculate the operating efficiency of pump. The operating efficiency was then compared with the rated efficiency and energy wastage in pumping systems was estimated.

Raw water pump no-1 (1F1)

Table 6.3 Operating raw water pump characteristics

S No.	Parameters	Winter	Summer
Measurement			
1	Discharge pressure (psi)	4.7	17
2	Suction pressure (psi)	2.5	1.5
3	Operating head in feet of water	5.1	35.8
3	flow rate (Usgpm)	76.0	177
4	Pump input kW	5.8	2.9
Analysis			
5	Pump efficiency (%)	1.3	41.1

In winter the operating raw water pump efficiency was only 1.3% but in summer it was increased to 41.1%. This was happening due to unnecessary throttling of the pump. However it is still less than the rated efficiency which is 50%.

Raw water domestic pump no-1 (1F3)

Table 6.4 Operating raw water domestic pump characteristics

S No.	Parameters	Winter	Summer
Measurement			
1	Discharge pressure (psi)	11.3	9.8
2	Suction pressure (psi)	2.5	1.5
3	Operating head in feet of water	20.3	19.1
3	flow rate (Usgpm)	168.0	179
4	Pump input kW	7.1	6.5
Analysis			
5	Pump efficiency (%)	9.1	9.9

There is hardly in improvement over pump's performance since winter. The operating efficiency of the pump is just 9.9% as compared to rated efficiency of 50%. This needs immediate attention.

Garden water pump no-1 (1F5)

Table 6.5 Operating garden water pump characteristics

S No.	Parameters	Winter	Summer
Measurement			
1	Discharge pressure (psi)	41.0	35.1

2	Suction pressure (psi)	2.7	1.5
3	Operating head in feet of water	88.4	77.5
3	flow rate (Usgpm)	32.0	63
4	Pump input kW	4.3	3
Analysis			
5	Pump efficiency (%)	12.5	30.7

Operating pump efficiency shows an upward improvement. Now in summer it is 30.7% instead of just 12.5% in winter. However, it is still just half of the rated efficiency which is 61%.

Domestic water pump no-1 (2F1)

Table 6.6 Operating domestic water pump characteristics

S No.	Parameters	Winter	Summer
Measurement			
1	Discharge pressure (psi)	150.0	146
2	Suction pressure (psi)	2.9	2.5
3	Operating head in feet of water	339.3	331.1
3	flow rate (Usgpm)	73.0	101
4	Pump input kW	10.9	11.6
Analysis			
5	Pump efficiency (%)	43.0	54.3

There is little improvement in summer pump efficiency as compared to winter efficiency and in fact it is better than the rated efficiency of 49%.

HVAC pump no-1 (2F3)

Table 6.7 Operating HVAC pump characteristics

S No.	Parameters	Winter	Summer
Measurement			
1	Discharge pressure (psi)	18.8	26
2	Suction pressure (psi)	2.9	1.5
3	Operating head in feet of water	36.6	56.5
3	flow rate (Usgpm)	55.0	155.4
4	Pump input kW	5.6	6.1
Analysis			
5	Pump efficiency (%)	6.8	27.1

No doubt the operating efficiency has increased from 6.8% in winter to 27.1% in summer yet it is very less as compared to rated efficiency of 50%.

Comparison of pumps operating efficiency v/s rated efficiency

Table 6.8 Rated and operating efficiency of the pumps

S No.	Pump	Rated efficiency (%)	Operating efficiency (%)
1	Raw water pump	50	41.1
2	Raw water domestic pump	50	9.9
3	Garden water pump	61	30.7
4	Domestic water pump	49	54.3
5	HVAC pump	50	27.1

Energy wastage due to low operating efficiency of pumps

Table 6.9 Energy wastage in pumping system

S No.	Pump	Input kW	Projected kW	Hrs/year	Energy wasted/year
1	Raw water pump	3.64	2.99	1800	1166
2	Raw water domestic pump	7.5	1.49	1800	10827
3	Garden water pump	3.84	1.93	1800	3433
4	HVAC pump	7.3	3.96	1800	6018
				Total	21445

Total wastage in pumping system : 21445 kWh/yr

6.5 Energy saving option: Resize installed pumps for higher efficiency

Using Grundfos pumps selection & sizing software and taking operating parameter of the pumps (mainly flow and head) all the pumps have been resized. Their rated motor capacity and actual motor input and estimated energy saving potential is listed in table 6.10 below.

Table 6.10 Energy performance of new pumps

S No.	Pump	Rated motor kW	Input motor kW	Existing motor input kW	kW saved	Hrs/year	Energy saving (kWh/Yr)
1	Raw water pump	3	2.29	3.6	1.35	1800	2430
2	Raw water domestic pump	1.5	1.26	7.5	6.24	1800	11232
3	Garden water pump	2.2	1.98	3.8	1.86	1800	3348
4	HVAC pump	4	3.61	7.3	3.69	1800	6642

Total annual energy saving potential	:	23652 kWh
Annual cost saving	:	Rs 128250
Initial investment required	:	Rs 120000
Simple payback	:	11 months

HAP 4.05 -Analysis for HVAC load estimation

Cooling Plant Sizing Summary for Central plant

Project Name signature tower
Prepared by: TERI

12/30/02
10:21 AM

1. Plant Information:

Plant Name	**Central plant**
Plant Class	**Cooling Plant**
Plant Type	**Chiller Plant**
Design Weather	**New Delhi, India**

2. Cooling Plant Sizing Data:

Maximum Plant Load	**1326.8** Tons
Load occurs at	**Jun 1800**
ft²/Ton	**189.6** ft²/Ton
Floor area served by plant	**251588.1** ft²

3. Coincident Air System Cooling Loads for Jun 1800

Air System Name	**Mult.**	**System Cooling Coil Load (Tons)**
AHU-1	1	18.8
AHU-2	1	57.8
AHU-3	1	32.9
AHU-4	1	35.1
AHU-5	1	47.9
AHU-6	1	46.9
AHU-7	1	41.1
AHU-8	5	51.3
AHU-9	8	41.8
AHU-18	3	40.0
AHU-24	1	40.2
AHU-25	1	37.3
AHU-26	1	50.9
AHU-27	2	43.2
AHU-28	1	34.3
AHU-30	1	38.7
AHU-31	1	47.7

System loads are for coils whose cooling source is ' Chilled Water '

Hourly Chiller Load Profiles for Central plant

Project Name: signature tower
Prepared by TERI

12/30/02
10:22 AM

1. Plant Information:

Plant Name ________ **Central plant**
Plant Class ________ **Cooling Plant**
Plant Type ________ **Chiller Plant**
Design Weather ________ **New Delhi, India**

2. Chiller Load Profiles from January to December :

	DESIGN MONTH : JANUARY		**DESIGN MONTH : FEBRUARY**		**DESIGN MONTH : MARCH**	
Hour	**OA TEMP (°F)**	**TOTAL COOLING (Tons)**	**OA TEMP (°F)**	**TOTAL COOLING (Tons)**	**OA TEMP (°F)**	**TOTAL COOLING (Tons)**
0000	48.4	0.0	52.0	0.0	56.3	0.0
0100	46.7	0.0	50.3	0.0	54.3	0.0
0200	44.9	0.0	48.6	0.0	52.2	0.0
0300	43.5	0.0	47.3	0.0	50.5	0.0
0400	42.5	0.0	46.2	0.0	49.3	0.0
0500	42.1	0.0	45.9	0.0	48.9	0.0
0600	42.8	0.0	46.6	0.0	49.7	0.0
0700	44.6	0.0	48.3	0.0	51.8	0.0
0800	47.7	83.7	51.3	110.2	55.5	557.4
0900	52.3	99.0	55.8	515.5	60.8	588.8
1000	57.5	567.3	60.9	594.0	67.0	650.5
1100	63.5	631.4	66.6	609.2	74.0	694.6
1200	69.1	611.8	72.1	653.1	80.6	670.2
1300	73.3	631.9	76.2	654.5	85.6	712.6
1400	76.1	648.1	78.9	668.7	88.9	740.4
1500	77.2	664.9	79.9	501.5	90.1	764.0
1600	76.1	649.9	78.9	671.0	88.9	752.4
1700	73.7	409.5	76.5	842.3	86.0	719.4
1800	69.8	361.3	72.8	638.3	81.4	580.2
1900	65.3	618.7	68.3	369.8	76.1	656.8
2000	60.7	252.9	63.9	609.5	70.7	695.3
2100	56.8	0.0	60.2	0.0	66.2	0.0
2200	53.3	0.0	56.8	0.0	62.1	0.0
2300	50.5	0.0	54.1	0.0	58.8	0.0
	Total Ton-hrs	**6230.5**		**7437.6**		**8782.7**

	DESIGN MONTH : APRIL		**DESIGN MONTH : MAY**		**DESIGN MONTH : JUNE**	
Hour	**OA TEMP (°F)**	**TOTAL COOLING (Tons)**	**OA TEMP (°F)**	**TOTAL COOLING (Tons)**	**OA TEMP (°F)**	**TOTAL COOLING (Tons)**
0000	69.7	0.0	73.4	0.0	78.5	0.0
0100	67.6	0.0	71.3	0.0	76.5	0.0
0200	65.5	0.0	69.1	0.0	74.4	0.0
0300	63.9	0.0	67.4	0.0	72.8	0.0
0400	62.6	0.0	66.1	0.0	71.6	0.0
0500	62.2	0.0	65.7	0.0	71.2	0.0
0600	63.0	0.0	66.6	0.0	72.0	0.0
0700	65.1	0.0	68.7	0.0	74.0	0.0
0800	68.8	636.8	72.6	789.1	77.7	977.4
0900	74.2	664.9	78.2	743.8	82.9	1037.7
1000	80.4	670.5	84.6	896.8	89.0	1092.1
1100	87.5	724.3	91.9	998.2	95.9	1132.9
1200	94.1	891.6	98.8	1140.3	102.4	1222.5
1300	99.0	962.0	104.0	1215.8	107.2	1217.4
1400	102.4	967.8	107.4	1279.1	110.5	1267.5
1500	103.6	1051.1	108.7	1223.4	111.7	1287.8
1600	102.4	993.7	107.4	1293.4	110.5	1288.2
1700	99.5	1052.2	104.4	1118.2	107.7	1241.7
1800	94.9	878.7	99.7	1139.5	103.2	1326.8
1900	89.5	811.8	94.1	1067.5	97.9	1140.0
2000	84.1	721.9	88.5	951.6	92.7	1036.3
2100	79.6	0.0	83.8	0.0	88.2	0.0
2200	75.4	0.0	79.5	0.0	84.2	0.0
2300	72.1	0.0	76.0	0.0	80.9	0.0
	Total Ton-hrs	**11027.3**		**13856.5**		**15268.2**

Hourly Chiller Load Profiles for Central plant

Project Name: signature tower
Prepared by: TERI

.	DESIGN MONTH : JULY		DESIGN MONTH : AUGUST		DESIGN MONTH : SEPTEMBER	
Hour	OA TEMP (°F)	TOTAL COOLING (Tons)	OA TEMP (°F)	TOTAL COOLING (Tons)	OA TEMP (°F)	TOTAL COOLING (Tons)
0000	81.1	0.0	79.6	0.0	76.2	0.0
0100	79.7	0.0	78.5	0.0	74.9	0.0
0200	78.3	0.0	77.3	0.0	73.6	0.0
0300	77.2	0.0	76.3	0.0	72.6	0.0
0400	76.4	0.0	75.6	0.0	71.9	0.0
0500	76.1	0.0	75.4	0.0	71.6	0.0
0600	76.7	0.0	75.9	0.0	72.1	0.0
0700	78.1	0.0	77.1	0.0	73.4	0.0
0800	80.6	1120.1	79.2	1063.6	75.7	868.5
0900	84.2	1100.5	82.2	1083.3	79.0	948.6
1000	88.4	1157.6	85.8	1130.2	82.8	989.6
1100	93.1	1212.0	89.8	1110.5	87.1	1054.6
1200	97.6	1203.4	93.6	1195.0	91.2	1081.7
1300	100.9	1246.8	96.4	1197.6	94.2	1061.2
1400	103.2	1289.3	98.3	1152.6	96.2	1077.4
1500	104.0	1284.2	99.0	1222.1	97.0	1087.0
1600	103.2	1299.0	98.3	1158.4	96.2	1085.7
1700	101.2	1252.7	96.6	1190.3	94.5	1114.2
1800	98.1	1258.5	94.0	1127.5	91.7	1069.9
1900	94.5	1143.9	91.0	1080.6	88.4	1032.4
2000	90.9	1101.5	87.9	1052.8	85.1	998.8
2100	87.8	0.0	85.3	0.0	82.3	0.0
2200	85.0	0.0	83.0	0.0	79.7	0.0
2300	82.8	0.0	81.1	0.0	77.7	0.0
	Total Ton-hrs	15669.5		14764.6		13469.6

	DESIGN MONTH : OCTOBER		DESIGN MONTH : NOVEMBER		DESIGN MONTH : DECEMBER	
Hour	OA TEMP (°F)	TOTAL COOLING (Tons)	OA TEMP (°F)	TOTAL COOLING (Tons)	OA TEMP (°F)	TOTAL COOLING (Tons)
0000	64.5	0.0	56.5	0.0	48.0	0.0
0100	62.8	0.0	54.2	0.0	46.1	0.0
0200	61.1	0.0	51.9	0.0	44.3	0.0
0300	59.7	0.0	50.0	0.0	42.9	0.0
0400	58.6	0.0	48.7	0.0	41.8	0.0
0500	58.3	0.0	48.2	0.0	41.4	0.0
0600	59.0	0.0	49.1	0.0	42.1	0.0
0700	60.7	0.0	51.4	0.0	44.0	0.0
0800	63.8	610.7	55.6	217.8	47.2	66.3
0900	68.3	416.9	61.6	577.6	52.0	95.2
1000	73.5	759.0	68.5	630.4	57.5	152.7
1100	79.3	754.9	76.3	458.9	63.7	207.4
1200	84.9	765.4	83.7	562.4	69.5	283.3
1300	89.0	903.6	89.2	657.9	73.9	376.3
1400	91.8	961.8	92.9	707.0	76.8	425.0
1500	92.8	956.8	94.3	747.9	77.9	458.8
1600	91.8	968.5	92.9	732.8	76.8	456.0
1700	89.4	834.3	89.7	681.1	74.3	402.9
1800	85.6	798.5	84.6	612.6	70.2	617.8
1900	81.1	817.9	78.6	662.8	65.5	449.0
2000	76.6	807.9	72.6	659.4	60.7	250.4
2100	72.8	0.0	67.6	0.0	56.7	0.0
2200	69.3	0.0	63.0	0.0	53.1	0.0
2300	66.6	0.0	59.3	0.0	50.2	0.0
	Total Ton-hrs	10356.1		7908.6		4241.1

Air System Sizing Summary for AHU-1

Project Name: signature tower
Prepared by TERI

12/30/02
10:24 AM

Air System Information

System Name	AHU-1		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	3113.7 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	18.8 Tons	Load occurs at	Jun 1800
Sensible coil load	14.6 Tons	OA DB / WB	103.2 / 81.1 °F
Coil CFM at Jun 1800	7226 CFM	Entering DB / WB	78.3 / 64.8 °F
Max possible CFM	7226 CFM	Leaving DB / WB	55.2 / 54.0 °F
Design supply temp	55.0 °F	Coil ADP	52.7 °F
ft²/Ton	165.4	Bypass factor	0.100
BTU/hr/ft²	72.5	Resulting RH	50 %
Water flow @ 10.0 °F rise	45.20 gpm	Zone T-stat Check	1 of 1 OK

Central Reheat Coil Sizing Data

Max coil load	101457 BTU/hr	Load occurs at	Mar 0800
Coil CFM at Mar 0800	7226 CFM	Ent. DB / Lvg DB	58.5 / 71.8 °F
Max possible CFM	7226 CFM		
Water flow @ 20.0 °F drop	10.15 gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1500	7226 CFM	Fan motor BHP	3.16 BHP
Standard CFM	7043 CFM	Fan motor kW	2.35 kW
Actual max CFM/ft²	2.32 CFM/ft²	Fan static	1.50 in wg.

Outdoor Ventilation Air Data

Design airflow CFM	780 CFM	CFM/person	10.00 CFM/person
CFM/ft²	0.25 CFM/ft²		

Air System Sizing Summary for AHU-2

Project Name: signature tower
Prepared by: TERI

12/30/02
10:24 AM

Air System Information

System Name	AHU-2		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	3791.4 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	57.8 Tons	Load occurs at	Jun 1800
Sensible coil load	39.6 Tons	OA DB / WB	103.2 / 81.1 °F
Coil CFM at Jun 1800	17873 CFM	Entering DB / WB	81.6 / 68.0 °F
Max possible CFM	17873 CFM	Leaving DB / WB	56.3 / 55.2 °F
Design supply temp.	55.0 °F	Coil ADP	53.5 °F
ft²/Ton	65.5	Bypass factor	0.100
BTU/hr/ft²	183.1	Resulting RH	52 %
Water flow @ 10.0 °F rise	138.92 gpm	Zone T-stat Check	0 of 1 OK

Central Reheat Coil Sizing Data

Max coil load	325911 BTU/hr	Load occurs at	Dec 0100
Coil CFM at Dec 0100	17873 CFM	Ent. DB / Lvg DB	36.8 / 54.1 °F
Max possible CFM	17873 CFM		
Water flow @ 20.0 °F drop	32.61 gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	17873 CFM	Fan motor BHP	7.81 BHP
Standard CFM	17421 CFM	Fan motor kW	5.82 kW
Actual max CFM/ft²	4.71 CFM/ft²	Fan static	1.50 in wg.

Outdoor Ventilation Air Data

Design airflow CFM	4071 CFM	CFM/person	15.54 CFM/person
CFM/ft²	1.07 CFM/ft²		

Air System Sizing Summary for AHU-3

Project Name: signature tower
Prepared by: TERI

12/30/02
10:24 AM

Air System Information

System Name	AHU-3		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	4989.6 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	33.7 Tons	Load occurs at	Jun 1500
Sensible coil load	30.9 Tons	OA DB / WB	111.7 / 76.8 °F
Coil CFM at Jun 1500	14494 CFM	Entering DB / WB	78.7 / 62.8 °F
Max possible CFM	14494 CFM	Leaving DB / WB	54.4 / 52.9 °F
Design supply temp.	55.0 °F	Coil ADP	51.7 °F
ft²/Ton	148.3	Bypass factor	0.100
BTU/hr/ft²	80.9	Resulting RH	45 %
Water flow @ 10.0 °F rise	80.81 gpm	Zone T-stat Check	0 of 1 OK

Central Reheat Coil Sizing Data

Max coil load	202930 BTU/hr	Load occurs at	Jan 1000
Coil CFM at Jan 1000	14494 CFM	Ent. DB / Lvg DB	55.0 / 68.3 °F
Max possible CFM	14494 CFM		
Water flow @ 20.0 °F drop	20.31 gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	14494 CFM	Fan motor BHP	6.33 BHP
Standard CFM	14127 CFM	Fan motor kW	4.72 kW
Actual max CFM/ft²	2.90 CFM/ft²	Fan static	1.50 in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	1091 CFM	CFM/person	16.53 CFM/person
CFM/ft²	0.22 CFM/ft²		

Air System Sizing Summary for AHU-4

Project Name: signature tower
Prepared by: TERI

12/30/02
10.25 AM

Air System Information

System Name	AHU-4		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	6452.2 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	35.1 Tons	Load occurs at	Jun 1800
Sensible coil load	26.3 Tons	OA DB / WB	103.2 / 81.1 °F
Coil CFM at Jun 1800	12066 CFM	Entering DB / WB	79.2 / 65.2 °F
Max possible CFM	12066 CFM	Leaving DB / WB	54.3 / 53.1 °F
Design supply temp.	55.0 °F	Coil ADP	51.6 °F
ft²/Ton	183.9	Bypass factor	0.100
BTU/hr/ft²	65.3	Resulting RH	49 %
Water flow @ 10.0 °F rise	84.28 gpm	Zone T-stat Check	1 of 1 OK

Central Reheat Coil Sizing Data

Max coil load	172635 BTU/hr	Load occurs at	Feb 0900
Coil CFM at Feb 0900	12066 CFM	Ent. DB / Lvg DB	58.2 / 71.8 °F
Max possible CFM	12066 CFM		
Water flow @ 20.0 °F drop	17.27 gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	12066 CFM	Fan motor BHP	5.27 BHP
Standard CFM	11760 CFM	Fan motor kW	3.93 kW
Actual max CFM/ft²	1.87 CFM/ft²	Fan static	1.50 in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	1620 CFM	CFM/person	10.00 CFM/person
CFM/ft²	0.25 CFM/ft²		

Air System Sizing Summary for AHU-5

Project Name signature tower
Prepared by TERI

12/30/02
10 25 AM

Air System Information

System Name	**AHU-5**		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**9357.3** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Cooling Coil Sizing Data

Total coil load	**47.9** Tons	Load occurs at	**Jun 1800**
Sensible coil load	**35.3** Tons	OA DB / WB	**103.2 / 81.1** °F
Coil CFM at Jun 1800	**15319** CFM	Entering DB / WB	**80.6 / 66.0** °F
Max possible CFM	**15319** CFM	Leaving DB / WB	**54.4 / 53.2** °F
Design supply temp	**55.0** °F	Coil ADP	**51.5** °F
ft²/Ton	**195.2**	Bypass factor	**0.100**
BTU/hr/ft²	**61.5**	Resulting RH	**49** %
Water flow @ 10.0 °F rise	**115.14** gpm	Zone T-stat Check	**0** of 1 OK

Central Reheat Coil Sizing Data

Max coil load	**188212** BTU/hr	Load occurs at	**Jan 0800**
Coil CFM at Jan 0800	**15319** CFM	Ent. DB / Lvg DB	**58.5 / 70.2** °F
Max possible CFM	**15319** CFM		
Water flow @ 20 0 °F drop	**18.83** gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	**15319** CFM	Fan motor BHP	**6.69** BHP
Standard CFM	**14932** CFM	Fan motor kW	**4.99** kW
Actual max CFM/ft²	**1.64** CFM/ft²	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**2340** CFM	CFM/person	**10.00** CFM/person
CFM/ft²	**0.25** CFM/ft²		

Air System Sizing Summary for AHU-6

Project Name. signature tower
Prepared by: TERI

12/30/02
10:25 AM

Air System Information

System Name	**AHU-6**		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**10008.0** ft^2

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Cooling Coil Sizing Data

Total coil load	**46.9** Tons	Load occurs at	**Jun 1800**
Sensible coil load	**36.6** Tons	OA DB / WB	**103.2 / 81.1** °F
Coil CFM at Jun 1800	**16234** CFM	Entering DB / WB	**79.6 / 64.7** °F
Max possible CFM	**16234** CFM	Leaving DB / WB	**53.9 / 52.6** °F
Design supply temp	**55.0** °F	Coil ADP	**51.0** °F
ft^2/Ton	**213.5**	Bypass factor	**0.100**
BTU/hr/ft^2	**56.2**	Resulting RH	**46** %
Water flow @ 10.0 °F rise	**112.55** gpm	Zone T-stat Check	**1 of 1** OK

Central Reheat Coil Sizing Data

Max coil load	**170295** BTU/hr	Load occurs at	**Jan 1000**
Coil CFM at Jan 1000	**16234** CFM	Ent. DB / Lvg DB	**59.8 / 69.8** °F
Max possible CFM	**16234** CFM		
Water flow @ 20 0 °F drop	**17.04** gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	**16234** CFM	Fan motor BHP	**7.09** BHP
Standard CFM	**15823** CFM	Fan motor kW	**5.29** kW
Actual max CFM/ft^2	**1.62** CFM/ft^2	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**2078** CFM	CFM/person	**15.62** CFM/person
CFM/ft^2	**0.21** CFM/ft^2		

Air System Sizing Summary for AHU-7

Project Name: signature tower
Prepared by TERI

12/30/02
10:26 AM

Air System Information

System Name	AHU-7		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**8647.3** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Cooling Coil Sizing Data

Total coil load	**41.1** Tons	Load occurs at	**Jun 1800**
Sensible coil load	**32.4** Tons	OA DB / WB	**103.2 / 81.1** °F
Coil CFM at Jun 1800	**14186** CFM	Entering DB / WB	**79.6 / 64.5** °F
Max possible CFM	**14903** CFM	Leaving DB / WB	**53.6 / 52.3** °F
Design supply temp.	**55.0** °F	Coil ADP	**50.7** °F
ft²/Ton	**210.6**	Bypass factor	**0.100**
BTU/hr/ft²	**57.0**	Resulting RH	**46** %
Water flow @ 10.0 °F rise	**98.61** gpm	Zone T-stat Check	**1 of 1** OK

Central Reheat Coil Sizing Data

No central reheat coil loads occurred during this calculation

Supply Fan Sizing Data

Actual max CFM at Jun 1600	**14903** CFM	Fan motor BHP	**6.51** BHP
Standard CFM	**14526** CFM	Fan motor kW	**4.86** kW
Actual max CFM/ft²	**1.72** CFM/ft²	Fan static	**1.50** in wg.

Outdoor Ventilation Air Data

Design airflow CFM	**1796** CFM	CFM/person	**15.62** CFM/person
CFM/ft²	**0.21** CFM/ft²		

Air System Sizing Summary for AHU-8

Project Name: signature tower
Prepared by: TERI

12/30/02
10:26 AM

Air System Information

System Name	AHU-8	Number of Zones	1
Equipment Class	CW AHU	Floor Area	9963.0 ft²
System Type	SZCAV		

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	51.3 Tons	Load occurs at	Jun 1800
Sensible coil load	41.0 Tons	OA DB / WB	103.2 / 81.1 °F
Coil CFM at Jun 1800	18461 CFM	Entering DB / WB	79.0 / 64.1 °F
Max possible CFM	18461 CFM	Leaving DB / WB	53.7 / 52.3 °F
Design supply temp.	55.0 °F	Coil ADP	50.9 °F
ft²/Ton	194.0	Bypass factor	0.100
BTU/hr/ft²	61.8	Resulting RH	46 %
Water flow @ 10.0 °F rise	123.30 gpm	Zone T-stat Check	1 of 1 OK

Central Reheat Coil Sizing Data

Max coil load	197423 BTU/hr	Load occurs at	Jan 1000
Coil CFM at Jan 1000	18461 CFM	Ent. DB / Lvg DB	59.7 / 69.9 °F
Max possible CFM	18461 CFM		
Water flow @ 20.0 °F drop	19.75 gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	18461 CFM	Fan motor BHP	8.07 BHP
Standard CFM	17994 CFM	Fan motor kW	6.02 kW
Actual max CFM/ft²	1.85 CFM/ft²	Fan static	1.50 in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	2069 CFM	CFM/person	15.56 CFM/person
CFM/ft²	0.21 CFM/ft²		

Air System Sizing Summary for AHU-9

Project Name: signature tower
Prepared by TERI

12/30/02
10:26 AM

Air System Information

System Name	AHU-9	Number of Zones	1
Equipment Class	CW AHU	Floor Area	8177.0 ft²
System Type	SZCAV		

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	41.8 Tons	Load occurs at	Jun 1800
Sensible coil load	33.4 Tons	OA DB / WB	103.2 / 81.1 °F
Coil CFM at Jun 1800	15453 CFM	Entering DB / WB	79.0 / 64.4 °F
Max possible CFM	15453 CFM	Leaving DB / WB	54.3 / 53.0 °F
Design supply temp.	55.0 °F	Coil ADP	51.6 °F
ft²/Ton	195.7	Bypass factor	0.100
BTU/hr/ft²	61.3	Resulting RH	47 %
Water flow @ 10.0 °F rise	100.34 gpm	Zone T-stat Check	1 of 1 OK

Central Reheat Coil Sizing Data

Max coil load	191542 BTU/hr	Load occurs at	Jan 1000
Coil CFM at Jan 1000	15453 CFM	Ent. DB / Lvg DB	59.8 / 71.6 °F
Max possible CFM	15453 CFM		
Water flow @ 20.0 °F drop	19.17 gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	15453 CFM	Fan motor BHP	6.75 BHP
Standard CFM	15061 CFM	Fan motor kW	5.04 kW
Actual max CFM/ft²	1.89 CFM/ft²	Fan static	1.50 in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	1698 CFM	CFM/person	15.58 CFM/person
CFM/ft²	0.21 CFM/ft²		

Air System Sizing Summary for AHU-18

Project Name signature tower
Prepared by TERI

12/30/02
10:27 AM

Air System Information

System Name	AHU-18		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	7796.1 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	40.0 Tons	Load occurs at	Jun 1800
Sensible coil load	31.9 Tons	OA DB / WB	103.2 / 81.1 °F
Coil CFM at Jun 1800	14676 CFM	Entering DB / WB	78.9 / 64.2 °F
Max possible CFM	14676 CFM	Leaving DB / WB	54.1 / 52.7 °F
Design supply temp.	55.0 °F	Coil ADP	51.3 °F
ft²/Ton	195.0	Bypass factor	0.100
BTU/hr/ft²	61.5	Resulting RH	47 %
Water flow @ 10.0 °F rise	95.99 gpm	Zone T-stat Check	1 of 1 OK

Central Reheat Coil Sizing Data

Max coil load	173597 BTU/hr	Load occurs at	Jan 1000
Coil CFM at Jan 1000	14676 CFM	Ent. DB / Lvg DB	60.1 / 71.3 °F
Max possible CFM	14676 CFM		
Water flow @ 20.0 °F drop	17.37 gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	14676 CFM	Fan motor BHP	6.41 BHP
Standard CFM	14305 CFM	Fan motor kW	4.78 kW
Actual max CFM/ft²	1.88 CFM/ft²	Fan static	1.50 in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	1619 CFM	CFM/person	15.57 CFM/person
CFM/ft²	0.21 CFM/ft²		

Air System Sizing Summary for AHU-24

Project Name signature tower
Prepared by TERI

12/30/02
10:27 AM

Air System Information

System Name	AHU-24		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	7796.1 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	40.2 Tons	Load occurs at	Jun 1800
Sensible coil load	32.2 Tons	OA DB / WB	103.2 / 81.1 °F
Coil CFM at Jun 1800	14740 CFM	Entering DB / WB	79.1 / 64.3 °F
Max possible CFM	14740 CFM	Leaving DB / WB	54.2 / 52.9 °F
Design supply temp	55.0 °F	Coil ADP	51.4 °F
ft²/Ton	194.1	Bypass factor	0.100
BTU/hr/ft²	61.8	Resulting RH	47 %
Water flow @ 10 0 °F rise	96.47 gpm	Zone T-stat Check	1 of 1 OK

Central Reheat Coil Sizing Data

Max coil load	174564 BTU/hr	Load occurs at	Jan 1000
Coil CFM at Jan 1000	14740 CFM	Ent. DB / Lvg DB	60.0 / 71.3 °F
Max possible CFM	14740 CFM		
Water flow @ 20 0 °F drop	17.47 gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	14740 CFM	Fan motor BHP	6.44 BHP
Standard CFM	14367 CFM	Fan motor kW	4.80 kW
Actual max CFM/ft²	1.89 CFM/ft²	Fan static	1.50 in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	1619 CFM	CFM/person	15.57 CFM/person
CFM/ft²	0.21 CFM/ft²		

Air System Sizing Summary for AHU-25

Project Name: signature tower
Prepared by: TERI

12/30/02
10:27 AM

Air System Information

System Name	AHU-25		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	8177.0 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	37.3 Tons	Load occurs at	Jun 1800
Sensible coil load	28.8 Tons	OA DB / WB	103.2 / 81.1 °F
Coil CFM at Jun 1800	12253 CFM	Entering DB / WB	80.4 / 65.0 °F
Max possible CFM	12253 CFM	Leaving DB / WB	53.6 / 52.2 °F
Design supply temp.	55.0 °F	Coil ADP	50.6 °F
ft²/Ton	219.3	Bypass factor	0.100
BTU/hr/ft²	54.7	Resulting RH	46 %
Water flow @ 10.0 °F rise	89.56 gpm	Zone T-stat Check	1 of 1 OK

Central Reheat Coil Sizing Data

Max coil load	84432 BTU/hr	Load occurs at	Jan 1000
Coil CFM at Jan 1000	12253 CFM	Ent DB / Lvg DB	59.8 / 66.4 °F
Max possible CFM	12253 CFM		
Water flow @ 20.0 °F drop	8.45 gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	12253 CFM	Fan motor BHP	5.35 BHP
Standard CFM	11943 CFM	Fan motor kW	3.99 kW
Actual max CFM/ft²	1.50 CFM/ft²	Fan static	1.50 in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	1698 CFM	CFM/person	15.58 CFM/person
CFM/ft²	0.21 CFM/ft²		

Air System Sizing Summary for AHU-26

Project Name: signature tower
Prepared by: TERI

12/30/02
10.28 AM

Air System Information

System Name	AHU-26		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	9722.1 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	51.2 Tons	Load occurs at	Jun 1500
Sensible coil load	45.7 Tons	OA DB / WB	111.7 / 76.8 °F
Coil CFM at Jun 1500	19660 CFM	Entering DB / WB	80.1 / 63.2 °F
Max possible CFM	19660 CFM	Leaving DB / WB	53.6 / 52.0 °F
Design supply temp.	55.0 °F	Coil ADP	50.6 °F
ft²/Ton	190.0	Bypass factor	0.100
BTU/hr/ft²	63.2	Resulting RH	44 %
Water flow @ 10.0 °F rise	122.89 gpm	Zone T-stat Check	0 of 1 OK

Central Reheat Coil Sizing Data

Max coil load	260828 BTU/hr	Load occurs at	Jan 1000
Coil CFM at Jan 1000	19660 CFM	Ent. DB / Lvg DB	59.5 / 72.1 °F
Max possible CFM	19660 CFM		
Water flow @ 20.0 °F drop	26.10 gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1500	19660 CFM	Fan motor BHP	8.59 BHP
Standard CFM	19162 CFM	Fan motor kW	6.41 kW
Actual max CFM/ft²	2.02 CFM/ft²	Fan static	1.50 in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	2019 CFM	CFM/person	15.65 CFM/person
CFM/ft²	0.21 CFM/ft²		

Air System Sizing Summary for AHU-27

Project Name.	signature tower		12/30/02
Prepared by	TERI		10:28 AM

Air System Information

System Name	AHU-27		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	8680.3 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Cooling Coil Sizing Data

Total coil load	**43.2** Tons	Load occurs at	**Jun 1800**
Sensible coil load	**34.3** Tons	OA DB / WB	**103.2 / 81.1** °F
Coil CFM at Jun 1800	**15713** CFM	Entering DB / WB	**79.2 / 64.5** °F
Max possible CFM	**15713** CFM	Leaving DB / WB	**54.3 / 53.0** °F
Design supply temp.	**55.0** °F	Coil ADP	**51.6** °F
ft²/Ton	**201.2**	Bypass factor	**0.100**
BTU/hr/ft²	**59.7**	Resulting RH	**47** %
Water flow @ 10.0 °F rise	**103.63** gpm	Zone T-stat Check	**1 of 1** OK

Central Reheat Coil Sizing Data

Max coil load	**191968** BTU/hr	Load occurs at	**Jan 1000**
Coil CFM at Jan 1000	**15713** CFM	Ent. DB / Lvg DB	**59.7 / 71.3** °F
Max possible CFM	**15713** CFM		
Water flow @ 20.0 °F drop	**19.21** gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	**15713** CFM	Fan motor BHP	**6.87** BHP
Standard CFM	**15315** CFM	Fan motor kW	**5.12** kW
Actual max CFM/ft²	**1.81** CFM/ft²	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**1803** CFM	CFM/person	**15.54** CFM/person
CFM/ft²	**0.21** CFM/ft²		

Air System Sizing Summary for AHU-28

Project Name signature tower
Prepared by TERI

12/30/02
10:28 AM

Air System Information

System Name	**AHU-28**		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**7436.6** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Cooling Coil Sizing Data

Total coil load	**34.3** Tons	Load occurs at	**Jun 1800**
Sensible coil load	**26.8** Tons	OA DB / WB	**103.2 / 81.1** °F
Coil CFM at Jun 1800	**12228** CFM	Entering DB / WB	**79.6 / 64.9** °F
Max possible CFM	**12228** CFM	Leaving DB / WB	**54.6 / 53.3** °F
Design supply temp	**55.0** °F	Coil ADP	**51.8** °F
ft²/Ton	**216.6**	Bypass factor	**0.100**
BTU/hr/ft²	**55.4**	Resulting RH	**47** %
Water flow @ 10.0 °F rise	**82.45** gpm	Zone T-stat Check	**1 of 1** OK

Central Reheat Coil Sizing Data

Max coil load	**127972** BTU/hr	Load occurs at	**Jan 1000**
Coil CFM at Jan 1000	**12228** CFM	Ent. DB / Lvg DB	**59.9 / 69.8** °F
Max possible CFM	**12228** CFM		
Water flow @ 20.0 °F drop	**12.81** gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1500	**12228** CFM	Fan motor BHP	**5.34** BHP
Standard CFM	**11918** CFM	Fan motor kW	**3.98** kW
Actual max CFM/ft²	**1.64** CFM/ft²	Fan static	**1.50** in wg.

Outdoor Ventilation Air Data

Design airflow CFM	**1545** CFM	CFM/person	**15.61** CFM/person
CFM/ft²	**0.21** CFM/ft²		

Air System Sizing Summary for AHU-30

Project Name: signature tower
Prepared by: TERI

12/30/02
10:29 AM

Air System Information

System Name	AHU-30		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	7436.6 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	*Jan to Dec*
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	38.7 Tons	Load occurs at	Jun 1800
Sensible coil load	31.1 Tons	OA DB / WB	103.2 / 81.1 °F
Coil CFM at Jun 1800	13378 CFM	Entering DB / WB	80.5 / 64.8 °F
Max possible CFM	13378 CFM	Leaving DB / WB	54.1 / 52.7 °F
Design supply temp.	55.0 °F	Coil ADP	51.1 °F
ft²/Ton	192.0	Bypass factor	0.100
BTU/hr/ft²	62.5	Resulting RH	46 %
Water flow @ 10.0 °F rise	93.01 gpm	Zone T-stat Check	1 of 1 OK

Central Reheat Coil Sizing Data

Max coil load	160260 BTU/hr	Load occurs at	Jan 1000
Coil CFM at Jan 1000	13378 CFM	Ent. DB / Lvg DB	59.9 / 71.3 °F
Max possible CFM	13378 CFM		
Water flow @ 20.0 °F drop	16.04 gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	13378 CFM	Fan motor BHP	5.85 BHP
Standard CFM	13039 CFM	Fan motor kW	4.36 kW
Actual max CFM/ft²	1.80 CFM/ft²	Fan static	1.50 in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	1545 CFM	CFM/person	15.61 CFM/person
CFM/ft²	0.21 CFM/ft²		

Air System Sizing Summary for AHU-31

Project Name: signature tower	12/30/02
Prepared by TERI	10:29 AM

Air System Information

System Name	AHU-31		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	8680.3 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	47.7 Tons	Load occurs at	Jun 1800
Sensible coil load	38.8 Tons	OA DB / WB	103.2 / 81.1 °F
Coil CFM at Jun 1800	16885 CFM	Entering DB / WB	80.5 / 64.7 °F
Max possible CFM	16885 CFM	Leaving DB / WB	54.3 / 52.9 °F
Design supply temp	55.0 °F	Coil ADP	51.4 °F
ft²/Ton	182.0	Bypass factor	0.100
BTU/hr/ft²	65.9	Resulting RH	47 %
Water flow @ 10.0 °F rise	114.53 gpm	Zone T-stat Check	1 of 1 OK

Central Reheat Coil Sizing Data

Max coil load	225514 BTU/hr	Load occurs at	Jan 1000
Coil CFM at Jan 1000	16885 CFM	Ent. DB / Lvg DB	59.8 / 72.5 °F
Max possible CFM	16885 CFM		
Water flow @ 20.0 °F drop	22.57 gpm		

Supply Fan Sizing Data

Actual max CFM at Jun 1600	16885 CFM	Fan motor BHP	7.38 BHP
Standard CFM	16458 CFM	Fan motor kW	5.50 kW
Actual max CFM/ft²	1.95 CFM/ft²	Fan static	1.50 in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	1803 CFM	CFM/person	15.54 CFM/person
CFM/ft²	0.21 CFM/ft²		

Heating Plant Sizing Summary for Central plant

Project Name: signature tower
Prepared by: TERI

12/30/02
11:59 AM

1. Plant Information:

Plant Name ____ Central plant
Plant Class ____ Heating Plant
Plant Type ____ Hot Water Boiler Plant
Design Weather ____ New Delhi, India

2. Heating Plant Sizing Data:

Maximum Plant Load ____ 5697 1 MBH
Load occurs at ____ Winter Design
BTU/hr/ft² ____ 22.6 BTU/hr/ft²
Floor area served by plant ____ 251588.1 ft²

3. Coincident Air System Heating Loads for Winter Design

Air System Name	Mult.	System Heating Coil Load (MBH)
AHU-1	1	96.9
AHU-2	1	290.3
AHU-3	1	191.4
AHU-4	1	157.9
AHU-5	1	175.6
AHU-6	1	196.6
AHU-7	1	159.7
AHU-8	5	218.2
AHU-9	8	170.2
AHU-18	3	177.7
AHU-24	1	181.4
AHU-25	1	124.8
AHU-26	1	249.3
AHU-27	2	176.6
AHU-28	1	148.7
AHU-30	1	177.9
AHU-31	1	207.6

System loads are for coils whose heating source is ' Hot Water '

Air System Sizing Summary for AHU-1

Project Name signature tower
Prepared by: TERI

12/30/02
12:00 PM

Air System Information

System Name	AHU-1		
Equipment Class	CW AHU	Number of Zones	**1**
System Type	SZCAV	Floor Area	**3113.7** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**96906** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**2049** CFM	BTU/hr/ft²	**31.1**
Max possible CFM	**2049** CFM	Ent. DB / Lvg DB	**61.8 / 106.7** °F
Water flow @ 2.5 °F drop	**77.57** gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	**2049** CFM	Fan motor BHP	**0.90** BHP
Standard CFM	**1997** CFM	Fan motor kW	**0.67** kW
Actual max CFM/ft²	**0.66** CFM/ft²	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**780** CFM	CFM/person	**10.00** CFM/person
CFM/ft²	**0.25** CFM/ft²		

Hourly Air System Design Day Loads for AHU-1

Project Name. signature tower 12/30
Prepared by TERI 12:00 P

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0800	55.6	2049	0.0	0.0	3.2	0.0	0.0	0.0	0.0
0900	61.6	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1000	68.5	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1100	76.3	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1200	83.7	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1300	89.2	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1400	92.9	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1500	94.3	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1600	92.9	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1700	89.7	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1800	84.6	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1900	78.6	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	72.6	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0800	47.2	2049	0.0	0.0	15.1	0.0	0.0	0.0	0.0
0900	52.0	2049	0.0	0.0	9.8	0.0	0.0	0.0	0.0
1000	57.5	2049	0.0	0.0	6.0	0.0	0.0	0.0	0.0
1100	63.7	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1200	69.5	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1300	73.9	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1400	76.8	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1500	77.9	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1600	76.8	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1700	74.3	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1800	70.2	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1900	65.5	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	60.7	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Hourly Air System Design Day Loads for AHU-1

roject Name: signature tower
repared by: TERI

12/30/02
12:00 PM

DESIGN MONTH: JANUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	2049	0.0	0.0	16.0	0.0	0.0	0.0	0.0	0
0900	52.3	2049	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0
1000	57.5	2049	0.0	0.0	6.1	0.0	0.0	0.0	0.0	0
1100	63.5	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.1	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	2049	0.0	0.0	12.4	0.0	0.0	0.0	0.0	0
0900	55.8	2049	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0
1000	60.9	2049	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0
1100	66.6	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	2049	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-2

Project Name. signature tower	12/30/02
Prepared by TERI	12:00 PM

Air System Information

System Name	AHU-2		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	3791.4 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**290348** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**4757** CFM	BTU/hr/ft²	**76.6**
Max possible CFM	**4757** CFM	Ent. DB / Lvg DB	**48.9 / 106.9** °F
Water flow @ 2.5 °F drop	**232.42** gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	**4757** CFM	Fan motor BHP	**2.08** BHP
Standard CFM	**4637** CFM	Fan motor kW	**1.55** kW
Actual max CFM/ft²	**1.25** CFM/ft²	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**4071** CFM	CFM/person	**15.54** CFM/person
CFM/ft²	**1.07** CFM/ft²		

Hourly Air System Design Day Loads for AHU-2

Project Name: signature tower
Prepared by: TERI

12/30/02
12:00 PM

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZO HEATI UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	4757	0.0	0.0	71.4	0.0	0.0	0.0	0.0	0
0900	61.6	4757	0.0	0.0	43.8	0.0	0.0	0.0	0.0	0
1000	68.5	4757	0.0	0.0	12.3	0.0	0.0	0.0	0.0	0
1100	76.3	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATI UN (MB
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	4757	0.0	0.0	164.3	0.0	0.0	0.0	0.0	0
0900	52.0	4757	0.0	0.0	108.1	0.0	0.0	0.0	0.0	0
1000	57.5	4757	0.0	0.0	57.7	0.0	0.0	0.0	0.0	0
1100	63.7	4757	0.0	0.0	35.0	0.0	0.0	0.0	0.0	0
1200	69.5	4757	0.0	0.0	10.2	0.0	0.0	0.0	0.0	0
1300	73.9	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	4757	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0
1900	65.5	4757	0.0	0.0	26.0	0.0	0.0	0.0	0.0	0
2000	60.7	4757	0.0	0.0	47.7	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-2

Project Name signature tower
Prepared by. TERI

12/30/02
12:00 PM

DESIGN MONTH: JANUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	4757	0.0	0.0	156.8	0.0	0.0	0.0	0.0	0
0900	52.3	4757	0.0	0.0	101.6	0.0	0.0	0.0	0.0	0
1000	57.5	4757	0.0	0.0	58.4	0.0	0.0	0.0	0.0	0
1100	63.5	4757	0.0	0.0	36.7	0.0	0.0	0.0	0.0	0
1200	69.1	4757	0.0	0.0	11.9	0.0	0.0	0.0	0.0	0
1300	73.3	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	4757	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0
1900	65.3	4757	0.0	0.0	26.8	0.0	0.0	0.0	0.0	0
2000	60.7	4757	0.0	0.0	47.6	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	4757	0.0	0.0	97.0	0.0	0.0	0.0	0.0	0
0900	55.8	4757	0.0	0.0	66.4	0.0	0.0	0.0	0.0	0
1000	60.9	4757	0.0	0.0	48.4	0.0	0.0	0.0	0.0	0
1100	66.6	4757	0.0	0.0	22.3	0.0	0.0	0.0	0.0	0
1200	72.1	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	4757	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	4757	0.0	0.0	12.0	0.0	0.0	0.0	0.0	0
2000	63.9	4757	0.0	0.0	32.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-3

Project Name. signature tower
Prepared by TERI

12/30/02
12:01 PM

Air System Information

System Name	**AHU-3**		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**4989.6** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**191444** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**4409** CFM	BTU/hr/ft²	**38.4**
Max possible CFM	**4409** CFM	Ent. DB / Lvg DB	**65.3 / 106.6** °F
Water flow @ 2.5 °F drop	**153.25** gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	**4409** CFM	Fan motor BHP	**1.93** BHP
Standard CFM	**4297** CFM	Fan motor kW	**1.44** kW
Actual max CFM/ft²	**0.88** CFM/ft²	Fan static	**1.50** in wg

Outdoor Ventilation Air Data

Design airflow CFM	**1091** CFM	CFM/person	**16.53** CFM/person
CFM/ft²	**0.22** CFM/ft²		

Hourly Air System Design Day Loads for AHU-3

Project Name: signature tower
Prepared by: TERI

12/30/02
12:01 PM

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	4409	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0
0900	61.6	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1000	68.5	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	4409	0.0	0.0	114.9	0.0	0.0	0.0	0.0	0
0900	52.0	4409	0.0	0.0	83.8	0.0	0.0	0.0	0.0	0
1000	57.5	4409	0.0	0.0	49.3	0.0	0.0	0.0	0.0	0
1100	63.7	4409	0.0	0.0	12.5	0.0	0.0	0.0	0.0	0
1200	69.5	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-3

Project Name: signature tower
Prepared by: TERI

12/30/02
12:01 PM

DESIGN MONTH: JANUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	4409	0.0	0.0	107.7	0.0	0.0	0.0	0.0	0
0900	52.3	4409	0.0	0.0	77.5	0.0	0.0	0.0	0.0	0
1000	57.5	4409	0.0	0.0	42.6	0.0	0.0	0.0	0.0	0
1100	63.5	4409	0.0	0.0	10.4	0.0	0.0	0.0	0.0	0
1200	69.1	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	4409	0.0	0.0	61.0	0.0	0.0	0.0	0.0	0
0900	55.8	4409	0.0	0.0	32.1	0.0	0.0	0.0	0.0	0
1000	60.9	4409	0.0	0.0	4.4	0.0	0.0	0.0	0.0	0
1100	66.6	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	4409	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-4

Project Name: signature tower
Prepared by: TERI

12/30/02
12:01 PM

Air System Information

System Name AHU-4
Equipment Class CW AHU
System Type SZCAV

Number of Zones 1
Floor Area 6452.2 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM **Peak zone sensible load**
Space CFM **Coincident space loads**

Calculation Months **Jan to Dec**
Sizing Data **Calculated**

Central Heating Coil Sizing Data

Max coil load **157855** BTU/hr
Coil CFM at Des Htg **3083** CFM
Max possible CFM **3083** CFM
Water flow @ 2.5 °F drop **126.36** gpm

Load occurs at **Des Htg**
BTU/hr/ft² **24.5**
Ent. DB / Lvg DB **57.9** / **106.5** °F

Supply Fan Sizing Data

Actual max CFM at Des Htg **3083** CFM
Standard CFM **3005** CFM
Actual max CFM/ft² **0.48** CFM/ft²

Fan motor BHP **1.35** BHP
Fan motor kW **1.00** kW
Fan static **1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM **1620** CFM
CFM/ft² **0.25** CFM/ft²

CFM/person **10.00** CFM/person

Hourly Air System Design Day Loads for AHU-4

Project Name: signature tower
Prepared by: TERI

12/30/02
12.01 PM

DESIGN MONTH: NOVEMBER										
Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	3083	0.0	0.0	13.6	0.0	0.0	0.0	0.0	0
0900	61.6	3083	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0
1000	68.5	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER										
Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	3083	0.0	0.0	34.8	0.0	0.0	0.0	0.0	0
0900	52.[illegible]	3083	0.0	0.0	27.0	0.0	0.0	0.0	0.0	0
1000	57.5	3083	0.0	0.0	16.3	0.0	0.0	0.0	0.0	0
1100	63.7	3083	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0
1200	69.5	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3083	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-4

Project Name signature tower
Prepared by TERI

12/30/02
12:02 PM

DESIGN MONTH: JANUARY										
Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	3083	0.0	0.0	34.1	0.0	0.0	0.0	0.0	0
0900	52.3	3083	0.0	0.0	26.7	0.0	0.0	0.0	0.0	0
1000	57.5	3083	0.0	0.0	16.5	0.0	0.0	0.0	0.0	0
1100	63.5	3083	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0
1200	69.1	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3083	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY										
Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	3083	0.0	0.0	26.9	0.0	0.0	0.0	0.0	0
0900	55.8	3083	0.0	0.0	17.9	0.0	0.0	0.0	0.0	0
1000	60.9	3083	0.0	0.0	7.6	0.0	0.0	0.0	0.0	0
1100	66.6	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	3083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-5

Project Name: signature tower
Prepared by TERI

12/30/02
12:02 PM

Air System Information

System Name	**AHU-5**	Number of Zones	**1**
Equipment Class	**CW AHU**	Floor Area	**9357.3** ft²
System Type	**SZCAV**		

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**175646** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**3007** CFM	BTU/hr/ft²	**18.8**
Max possible CFM	**3007** CFM	Ent. DB / Lvg DB	**51.0 / 106.5** °F
Water flow @ 2.5 °F drop	**140.60** gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	**3007** CFM	Fan motor BHP	**1.31** BHP
Standard CFM	**2931** CFM	Fan motor kW	**0.98** kW
Actual max CFM/ft²	**0.32** CFM/ft²	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**2340** CFM	CFM/person	**10.00** CFM/person
CFM/ft²	**0.25** CFM/ft²		

Hourly Air System Design Day Loads for AHU-5

Project Name: signature tower
Prepared by: TERI

12/30/02
12.02 PM

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	3007	0.0	0.0	26.9	0.0	0.0	0.0	0.0	0
0900	61.6	3007	0.0	0.0	11.3	0.0	0.0	0.0	0.0	0
1000	68.5	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	3007	0.0	0.0	53.1	0.0	0.0	0.0	0.0	0
0900	52.0	3007	0.0	0.0	40.5	0.0	0.0	0.0	0.0	0
1000	57.5	3007	0.0	0.0	26.1	0.0	0.0	0.0	0.0	0
1100	63.7	3007	0.0	0.0	9.8	0.0	0.0	0.0	0.0	0
1200	69.5	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-5

Project Name signature tower
Prepared by TERI

12/30/02
12:02 PM

DESIGN MONTH: JANUARY										
Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	3007	0.0	0.0	51.7	0.0	0.0	0.0	0.0	0
0900	52.3	3007	0.0	0.0	39.6	0.0	0.0	0.0	0.0	0
1000	57.5	3007	0.0	0.0	26.0	0.0	0.0	0.0	0.0	0
1100	63.5	3007	0.0	0.0	10.2	0.0	0.0	0.0	0.0	0
1200	69.1	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	3007	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0
2000	60.7	3007	0.0	0.0	13.6	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY										
Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	3007	0.0	0.0	40.7	0.0	0.0	0.0	0.0	0
0900	55.8	3007	0.0	0.0	28.9	0.0	0.0	0.0	0.0	0
1000	60.9	3007	0.0	0.0	15.6	0.0	0.0	0.0	0.0	0
1100	66.6	3007	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0
1200	72.1	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	3007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	3007	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-6

Project Name: signature tower
Prepared by TERI

12/30/02
12:02 PM

Air System Information

System Name ____ **AHU-6**
Equipment Class ____ **CW AHU**
System Type ____ **SZCAV**

Number of Zones ____ **1**
Floor Area ____ **10008.0** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ____ **Peak zone sensible load**
Space CFM ____ **Coincident space loads**

Calculation Months ____ **Jan to Dec**
Sizing Data ____ **Calculated**

Central Heating Coil Sizing Data

Max coil load ____ **196623** BTU/hr
Coil CFM at Des Htg ____ **3754** CFM
Max possible CFM ____ **3754** CFM
Water flow @ 2.5 °F drop ____ **157.39** gpm

Load occurs at ____ **Des Htg**
BTU/hr/ft² ____ **19.6**
Ent. DB / Lvg DB ____ **57.1 / 106.9** °F

Supply Fan Sizing Data

Actual max CFM at Des Htg ____ **3754** CFM
Standard CFM ____ **3659** CFM
Actual max CFM/ft² ____ **0.38** CFM/ft²

Fan motor BHP ____ **1.64** BHP
Fan motor kW ____ **1.22** kW
Fan static ____ **1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM ____ **2078** CFM
CFM/ft² ____ **0.21** CFM/ft²

CFM/person ____ **15.62** CFM/person

Hourly Air System Design Day Loads for AHU-6

Project Name: signature tower
Prepared by: TERI

12/30/02
12.02 PM

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	3754	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0
0900	61.6	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1000	68.5	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	3754	0.0	0.0	38.7	0.0	0.0	0.0	0.0	0
0900	52.0	3754	0.0	0.0	24.4	0.0	0.0	0.0	0.0	0
1000	57.5	3754	0.0	0.0	9.6	0.0	0.0	0.0	0.0	0
1100	63.7	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.5	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-6

Project Name signature tower
Prepared by TERI

12/30/02
12:03 PM

DESIGN MONTH: JANUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	3754	0.0	0.0	37.3	0.0	0.0	0.0	0.0	0
0900	52.3	3754	0.0	0.0	23.4	0.0	0.0	0.0	0.0	0
1000	57.5	3754	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0
1100	63.5	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.1	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	3754	0.0	0.0	23.7	0.0	0.0	0.0	0.0	0
0900	55.8	3754	0.0	0.0	10.7	0.0	0.0	0.0	0.0	0
1000	60.9	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	66.6	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	3754	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-7

Project Name: signature tower
Prepared by: TERI

12/30/02
12:03 PM

Air System Information

System Name	**AHU-7**		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**8647.3** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**159738** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**2932** CFM	BTU/hr/ft²	**18.5**
Max possible CFM	**2932** CFM	Ent. DB / Lvg DB	**55.5 / 107.3** °F
Water flow @ 2.5 °F drop	**127.87** gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	**2932** CFM	Fan motor BHP	**1.28** BHP
Standard CFM	**2858** CFM	Fan motor kW	**0.96** kW
Actual max CFM/ft²	**0.34** CFM/ft²	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**1796** CFM	CFM/person	**15.62** CFM/person
CFM/ft²	**0.21** CFM/ft²		

Hourly Air System Design Day Loads for AHU-7

Project Name: signature tower
Prepared by: TERI

12/30/02
12:03 PM

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	2932	0.0	0.0	11.1	0.0	0.0	0.0	0.0	0
0900	61.6	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1000	68.5	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	2932	0.0	0.0	36.0	0.0	0.0	0.0	0.0	0
0900	52.0	2932	0.0	0.0	25.2	0.0	0.0	0.0	0.0	0
1000	57.5	2932	0.0	0.0	12.7	0.0	0.0	0.0	0.0	0
1100	63.7	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.5	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	2932	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-7

Project Name: signature tower
Prepared by TERI

12/30/02
12:03 PM

DESIGN MONTH: JANUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	2932	0.0	0.0	34.8	0.0	0.0	0.0	0.0	0
0900	52.3	2932	0.0	0.0	24.4	0.0	0.0	0.0	0.0	0
1000	57.5	2932	0.0	0.0	12.7	0.0	0.0	0.0	0.0	0
1100	63.5	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.1	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	2932	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	2932	0.0	0.0	24.5	0.0	0.0	0.0	0.0	0
0900	55.8	2932	0.0	0.0	14.4	0.0	0.0	0.0	0.0	0
1000	60.9	2932	0.0	0.0	3.1	0.0	0.0	0.0	0.0	0
1100	66.6	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	2932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-8

Project Name: signature tower	12/30/02
Prepared by: TERI	12:03 PM

Air System Information

System Name	**AHU-8**		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**9963.0** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**218168** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**4369** CFM	BTU/hr/ft²	**21.9**
Max possible CFM	**4369** CFM	Ent. DB / Lvg DB	**59.3 / 106.7** °F
Water flow @ 2.5 °F drop	**174.64** gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	**4369** CFM	Fan motor BHP	**1.91** BHP
Standard CFM	**4259** CFM	Fan motor kW	**1.42** kW
Actual max CFM/ft²	**0.44** CFM/ft²	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**2069** CFM	CFM/person	**15.56** CFM/person
CFM/ft²	**0.21** CFM/ft²		

Hourly Air System Design Day Loads for AHU-8

Project Name: signature tower
Prepared by: TERI

12/30/02
12.03 PM

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	4369	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0
0900	61.6	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1000	68.5	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MB
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	4369	0.0	0.0	37.9	0.0	0.0	0.0	0.0	0
0900	52.0	4369	0.0	0.0	22.8	0.0	0.0	0.0	0.0	0
1000	57.5	4369	0.0	0.0	7.3	0.0	0.0	0.0	0.0	0
1100	63.7	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.5	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-8

Project Name: signature tower
Prepared by: TERI

12/30/02
12:03 PM

DESIGN MONTH: JANUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	4369	0.0	0.0	36.4	0.0	0.0	0.0	0.0	0
0900	52.3	4369	0.0	0.0	21.6	0.0	0.0	0.0	0.0	0
1000	57.5	4369	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0
1100	63.5	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.1	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	4369	0.0	0.0	21.2	0.0	0.0	0.0	0.0	0
0900	55.8	4369	0.0	0.0	7.5	0.0	0.0	0.0	0.0	0
1000	60.9	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	66.6	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	4369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-9

Project Name signature tower	12/30/02
Prepared by TERI	12:04 PM

Air System Information

System Name	**AHU-9**		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**8177.0** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**170212** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**3330** CFM	BTU/hr/ft²	**20.8**
Max possible CFM	**3330** CFM	Ent. DB / Lvg DB	**58.3 / 106.9** °F
Water flow @ 2.5 °F drop	**136.25** gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	**3330** CFM	Fan motor BHP	**1.46** BHP
Standard CFM	**3246** CFM	Fan motor kW	**1.09** kW
Actual max CFM/ft²	**0.41** CFM/ft²	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**1698** CFM	CFM/person	**15.58** CFM/person
CFM/ft²	**0.21** CFM/ft²		

Hourly Air System Design Day Loads for AHU-9

Project Name: signature tower
Prepared by. TERI

12/30/02
12.04 PM

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	3330	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0
0900	61.6	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1000	68.5	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH· DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	3330	0.0	0.0	34.5	0.0	0.0	0.0	0.0	0
0900	52.0	3330	0.0	0.0	23.5	0.0	0.0	0.0	0.0	0
1000	57.5	3330	0.0	0.0	10.9	0.0	0.0	0.0	0.0	0
1100	63.7	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.5	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-9

Project Name: signature tower
Prepared by TERI

12/30/02
12.04 PM

DESIGN MONTH: JANUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	3330	0.0	0.0	32.1	0.0	0.0	0.0	0.0	0
0900	52.3	3330	0.0	0.0	22.8	0.0	0.0	0.0	0.0	0
1000	57.5	3330	0.0	0.0	10.9	0.0	0.0	0.0	0.0	0
1100	63.5	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.1	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	3330	0.0	0.0	22.5	0.0	0.0	0.0	0.0	0
0900	55.8	3330	0.0	0.0	12.3	0.0	0.0	0.0	0.0	0
1000	60.9	3330	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0
1100	66.6	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	3330	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-18

Project Name signature tower
Prepared by TERI

12/30/02
12:04 PM

Air System Information

System Name	**AHU-18**		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**7796.1** ft^2

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**177704** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**3597** CFM	BTU/hr/ft^2	**22.8**
Max possible CFM	**3597** CFM	Ent. DB / Lvg DB	**59.9 / 106.9** °F
Water flow @ 2.5 °F drop	**142.25** gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	**3597** CFM	Fan motor BHP	**1.57** BHP
Standard CFM	**3506** CFM	Fan motor kW	**1.17** kW
Actual max CFM/ft^2	**0.46** CFM/ft^2	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**1619** CFM	CFM/person	**15.57** CFM/person
CFM/ft^2	**0.21** CFM/ft^2		

Hourly Air System Design Day Loads for AHU-18

Project Name. signature tower
Prepared by. TERI

12/30/02
12:04 PM

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0900	61.6	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1000	68.5	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	3597	0.0	0.0	30.1	0.0	0.0	0.0	0.0	0
0900	52.0	3597	0.0	0.0	17.8	0.0	0.0	0.0	0.0	0
1000	57.5	3597	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0
1100	63.7	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.5	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-18

Project Name signature tower
Prepared by: TERI

12/30/02
12.04 PM

DESIGN MONTH: JANUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	3597	0.0	0.0	28.9	0.0	0.0	0.0	0.0	0
0900	52.3	3597	0.0	0.0	16.8	0.0	0.0	0.0	0.0	0
1000	57.5	3597	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0
1100	63.5	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.1	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	3597	0.0	0.0	16.4	0.0	0.0	0.0	0.0	0
0900	55.8	3597	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0
1000	60.9	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	66.6	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	3597	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-24

Project Name	signature tower		12/30/02
Prepared by:	TERI		12:05 PM

Air System Information

System Name	**AHU-24**		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**7796.1** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**181382** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**3662** CFM	BTU/hr/ft²	**23.3**
Max possible CFM	**3662** CFM	Ent. DB / Lvg DB	**60.2 / 107.2** °F
Water flow @ 2.5 °F drop	**145.19** gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	**3662** CFM	Fan motor BHP	**1.60** BHP
Standard CFM	**3569** CFM	Fan motor kW	**1.19** kW
Actual max CFM/ft²	**0.47** CFM/ft²	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**1619** CFM	CFM/person	**15.57** CFM/person
CFM/ft²	**0.21** CFM/ft²		

Hourly Air System Design Day Loads for AHU-24

Project Name: signature tower
Prepared by: TERI

12/30/02
12:05 PM

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0900	61.6	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1000	68.5	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	3662	0.0	0.0	30.4	0.0	0.0	0.0	0.0	0
0900	52.0	3662	0.0	0.0	18.1	0.0	0.0	0.0	0.0	0
1000	57.5	3662	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0
1100	63.7	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.5	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-24

Project Name signature tower
Prepared by TERI

12/30/02
12:05 PM

DESIGN MONTH: JANUARY										
Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	3662	0.0	0.0	29.2	0.0	0.0	0.0	0.0	0
0900	52.3	3662	0.0	0.0	17.0	0.0	0.0	0.0	0.0	0
1000	57.5	3662	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0
1100	63.5	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.1	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY										
Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	3662	0.0	0.0	16.3	0.0	0.0	0.0	0.0	0
0900	55.8	3662	0.0	0.0	5.1	0.0	0.0	0.0	0.0	0
1000	60.9	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	66.6	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	3662	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-25

Project Name signature tower	12/30/02
Prepared by TERI	12.05 PM

Air System Information

System Name	AHU-25		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	8177.0 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**124840** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**2056** CFM	BTU/hr/ft²	**15.3**
Max possible CFM	**2056** CFM	Ent. DB / Lvg DB	**49.7 / 107.4** °F
Water flow @ 2.5 °F drop	**99.93** gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	**2056** CFM	Fan motor BHP	**0.90** BHP
Standard CFM	**2003** CFM	Fan motor kW	**0.67** kW
Actual max CFM/ft²	**0.25** CFM/ft²	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**1698** CFM	CFM/person	**15.58** CFM/person
CFM/ft²	**0.21** CFM/ft²		

Hourly Air System Design Day Loads for AHU-25

Project Name: signature tower
Prepared by. TERI

12/30/
12:05 P

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	Z HEAT L (M
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0800	55.6	2056	0.0	0.0	18.5	0.0	0.0	0.0	0.0	
0900	61.6	2056	0.0	0.0	7.0	0.0	0.0	0.0	0.0	
1000	68.5	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1100	76.3	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1200	83.7	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1300	89.2	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1400	92.9	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1500	94.3	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1600	92.9	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1700	89.7	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1800	84.6	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH· DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	2056	0.0	0.0	37.0	0.0	0.0	0.0	0.0	0
0900	52.0	2056	0.0	0.0	27.7	0.0	0.0	0.0	0.0	0
1000	57.5	2056	0.0	0.0	17.0	0.0	0.0	0.0	0.0	0
1100	63.7	2056	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0
1200	69.5	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	2056	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0
2000	60.7	2056	0.0	0.0	9.5	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-25

Project Name signature tower
Prepared by TERI

12/30/02
12:05 PM

DESIGN MONTH: JANUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	2056	0.0	0.0	36.0	0.0	0.0	0.0	0.0	0
0900	52.3	2056	0.0	0.0	27.1	0.0	0.0	0.0	0.0	0
1000	57.5	2056	0.0	0.0	17.0	0.0	0.0	0.0	0.0	0
1100	63.5	2056	0.0	0.0	5.3	0.0	0.0	0.0	0.0	0
1200	69.1	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	2056	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0
2000	60.7	2056	0.0	0.0	9.4	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	2056	0.0	0.0	28.1	0.0	0.0	0.0	0.0	0
0900	55.8	2056	0.0	0.0	19.4	0.0	0.0	0.0	0.0	0
1000	60.9	2056	0.0	0.0	9.6	0.0	0.0	0.0	0.0	0
1100	66.6	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	2056	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
000	63.9	2056	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0
100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-26

Project Name signature tower
Prepared by: TERI

12/30/02
12.16 PM

Air System Information

System Name	**AHU-26**		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**9722.1** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**249303** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**5285** CFM	BTU/hr/ft²	**25.6**
Max possible CFM	**5285** CFM	Ent. DB / Lvg DB	**61.7 / 106.5** °F
Water flow @ 2.5 °F drop	**199.56** gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	**5285** CFM	Fan motor BHP	**2.31** BHP
Standard CFM	**5151** CFM	Fan motor kW	**1.72** kW
Actual max CFM/ft²	**0.54** CFM/ft²	Fan static	**1.50** in. wg.

)utdoor Ventilation Air Data

Design airflow CFM	**2019** CFM	CFM/person	**15.65** CFM/person
CFM/ft²	**0.21** CFM/ft²		

Hourly Air System Design Day Loads for AHU-26

Project Name: signature tower
Prepared by: TERI

12/30/0
12.16 P

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZO HEATI UN (MB
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	5285	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0
0900	61.6	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1000	68.5	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	5285	0.0	0.0	32.8	0.0	0.0	0.0	0.0	0
0900	52.0	5285	0.0	0.0	28.3	0.0	0.0	0.0	0.0	0
1000	57.5	5285	0.0	0.0	10.7	0.0	0.0	0.0	0.0	0
1100	63.7	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.5	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-26

Project Name. signature tower
Prepared by TERI

12/30/02
12:16 PM

DESIGN MONTH: JANUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	5285	0.0	0.0	32.2	0.0	0.0	0.0	0.0	0
0900	52.3	5285	0.0	0.0	25.1	0.0	0.0	0.0	0.0	0
1000	57.5	5285	0.0	0.0	10.5	0.0	0.0	0.0	0.0	0
1100	63.5	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.1	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	5285	0.0	0.0	27.3	0.0	0.0	0.0	0.0	0
0900	55.8	5285	0.0	0.0	11.9	0.0	0.0	0.0	0.0	0
1000	60.9	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	66.6	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
700	76.5	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
800	72.8	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
900	68.3	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
000	63.9	5285	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-27

Project Name. signature tower
Prepared by TERI

12/30/02
12.06 PM

Air System Information

System Name	**AHU-27**		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**8680.3** ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

Central Heating Coil Sizing Data

Max coil load	**176583** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**3386** CFM	BTU/hr/ft²	**20.3**
Max possible CFM	**3386** CFM	Ent. DB / Lvg DB	**57.7 / 107.3** °F
Water flow @ 2.5 °F drop	**141.35** gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	**3386** CFM	Fan motor BHP	**1.48** BHP
Standard CFM	**3300** CFM	Fan motor kW	**1.10** kW
Actual max CFM/ft²	**0.39** CFM/ft²	Fan static	**1.50** in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	**1803** CFM	CFM/person	**15.54** CFM/person
CFM/ft²	**0.21** CFM/ft²		

Hourly Air System Design Day Loads for AHU-27

Project Name. signature tower
Prepared by: TERI

12/30/02
12.06 PM

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	3386	0.0	0.0	10.1	0.0	0.0	0.0	0.0	0
0900	61.6	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1000	68.5	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	3386	0.0	0.0	35.7	0.0	0.0	0.0	0.0	0
0900	52.0	3386	0.0	0.0	25.7	0.0	0.0	0.0	0.0	0
1000	57.5	3386	0.0	0.0	12.7	0.0	0.0	0.0	0.0	0
1100	63.7	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.5	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-27

Project Name signature tower
Prepared by TERI

12/30/02
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DESIGN MONTH: JANUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	3386	0.0	0.0	35.1	0.0	0.0	0.0	0.0	0
0900	52.3	3386	0.0	0.0	24.9	0.0	0.0	0.0	0.0	0
1000	57.5	3386	0.0	0.0	12.7	0.0	0.0	0.0	0.0	0
1100	63.5	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.1	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	3386	0.0	0.0	24.8	0.0	0.0	0.0	0.0	0
0900	55.8	3386	0.0	0.0	14.4	0.0	0.0	0.0	0.0	0
1000	60.9	3386	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0
1100	66.6	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	3386	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-28

Project Name signature tower
Prepared by TERI

12/30/02
12:06 PM

Air System Information

System Name	AHU-28		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	7436.6 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Heating Coil Sizing Data

Max coil load	148660 BTU/hr	Load occurs at	Des Htg
Coil CFM at Des Htg	2841 CFM	BTU/hr/ft²	20.0
Max possible CFM	2841 CFM	Ent. DB / Lvg DB	57.4 / 107.1 °F
Water flow @ 2.5 °F drop	119.00 gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	2841 CFM	Fan motor BHP	1.24 BHP
Standard CFM	2769 CFM	Fan motor kW	0.93 kW
Actual max CFM/ft²	0.38 CFM/ft²	Fan static	1.50 in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	1545 CFM	CFM/person	15.61 CFM/person
CFM/ft²	0.21 CFM/ft²		

Hourly Air System Design Day Loads for AHU-28

Project Name: signature tower
Prepared by: TERI

12/30/02
12.06 PM

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	2841	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0
0900	61.6	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1000	68.5	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	2841	0.0	0.0	29.5	0.0	0.0	0.0	0.0	0
0900	52.0	2841	0.0	0.0	18.6	0.0	0.0	0.0	0.0	0
1000	57.5	2841	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0
1100	63.7	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.5	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-28

Project Name: signature tower
Prepared by TERI

12/30/02
12:06 PM

DESIGN MONTH: JANUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	2841	0.0	0.0	28.7	0.0	0.0	0.0	0.0	0
0900	52.3	2841	0.0	0.0	18.2	0.0	0.0	0.0	0.0	0
1000	57.5	2841	0.0	0.0	7.2	0.0	0.0	0.0	0.0	0
1100	63.5	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.1	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	2841	0.0	0.0	19.5	0.0	0.0	0.0	0.0	0
0900	55.8	2841	0.0	0.0	9.7	0.0	0.0	0.0	0.0	0
1000	60.9	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	66.6	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	2841	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-30

Project Name: signature tower
Prepared by TERI

12/30/02
12:07 PM

Air System Information

System Name	AHU-30		
Equipment Class	CW AHU	Number of Zones	1
System Type	SZCAV	Floor Area	7436.6 ft²

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Coincident space loads	Sizing Data	Calculated

Central Heating Coil Sizing Data

Max coil load	177886 BTU/hr	Load occurs at	Des Htg
Coil CFM at Des Htg	3648 CFM	BTU/hr/ft²	23.9
Max possible CFM	3648 CFM	Ent. DB / Lvg DB	60.6 / 107.0 °F
Water flow @ 2.5 °F drop	142.40 gpm		

Supply Fan Sizing Data

Actual max CFM at Des Htg	3648 CFM	Fan motor BHP	1.59 BHP
Standard CFM	3556 CFM	Fan motor kW	1.19 kW
Actual max CFM/ft²	0.49 CFM/ft²	Fan static	1.50 in. wg.

Outdoor Ventilation Air Data

Design airflow CFM	1545 CFM	CFM/person	15.61 CFM/person
CFM/ft²	0.21 CFM/ft²		

Hourly Air System Design Day Loads for AHU-30

Project Name: signature tower
Prepared by TERI

12/30/02
12:07 PM

DESIGN MONTH: NOVEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	56.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	54.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	51.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	50.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	48.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	48.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	49.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	51.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	55.6	3648	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0
0900	61.6	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1000	68.5	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	76.3	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	83.7	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	89.2	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	92.9	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	94.3	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	92.9	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	89.7	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	84.6	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	78.6	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	72.6	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	67.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	63.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	59.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: DECEMBER

Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	42.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	41.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	41.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.2	3648	0.0	0.0	32.9	0.0	0.0	0.0	0.0	0
0900	52.0	3648	0.0	0.0	21.2	0.0	0.0	0.0	0.0	0
1000	57.5	3648	0.0	0.0	8.8	0.0	0.0	0.0	0.0	0
1100	63.7	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.5	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.9	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.8	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.9	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.8	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	74.3	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	70.2	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.5	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Hourly Air System Design Day Loads for AHU-30

Project Name: signature tower
Prepared by TERI

12/30/02
12:07 PM

DESIGN MONTH: JANUARY										
Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	48.4	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	46.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	44.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	43.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	42.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	42.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	42.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	44.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	47.7	3648	0.0	0.0	31.5	0.0	0.0	0.0	0.0	0
0900	52.3	3648	0.0	0.0	20.2	0.0	0.0	0.0	0.0	0
1000	57.5	3648	0.0	0.0	8.4	0.0	0.0	0.0	0.0	0
1100	63.5	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	69.1	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	73.3	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	76.1	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	77.2	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	76.1	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	73.7	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	69.8	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	65.3	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	60.7	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	53.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	50.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

DESIGN MONTH: FEBRUARY										
Hour	OA TEMP (°F)	SUPPLY AIRFLOW (CFM)	CENTRAL COOLING SENSIBLE (MBH)	CENTRAL COOLING TOTAL (MBH)	CENTRAL HEATING COIL (MBH)	PRECOOL COIL (MBH)	PREHEAT COIL (MBH)	TERMINAL COOLING (MBH)	TERMINAL HEATING (MBH)	ZON HEATIN UN (MBH
0000	52.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0100	50.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0200	48.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0300	47.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0400	46.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0500	45.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0600	46.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0700	48.3	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
0800	51.3	3648	0.0	0.0	18.8	0.0	0.0	0.0	0.0	0
0900	55.8	3648	0.0	0.0	8.4	0.0	0.0	0.0	0.0	0
1000	60.9	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1100	66.6	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1200	72.1	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1300	76.2	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1400	78.9	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1500	79.9	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1600	78.9	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1700	76.5	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1800	72.8	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1900	68.3	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2000	63.9	3648	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2100	60.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2200	56.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2300	54.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Air System Sizing Summary for AHU-31

oject Name signature tower			12/30/02
epared by TERI			12:07 PM

r System Information

System Name	**AHU-31**		
Equipment Class	**CW AHU**	Number of Zones	**1**
System Type	**SZCAV**	Floor Area	**8680.3** ft^2

zing Calculation Information

one and Space Sizing Method:

Zone CFM	**Peak zone sensible load**	Calculation Months	**Jan to Dec**
Space CFM	**Coincident space loads**	Sizing Data	**Calculated**

ntral Heating Coil Sizing Data

Max coil load	**207618** BTU/hr	Load occurs at	**Des Htg**
Coil CFM at Des Htg	**4290** CFM	BTU/hr/ft^2	**23.9**
Max possible CFM	**4290** CFM	Ent. DB / Lvg DB	**60.7 / 106.7** °F
Water flow @ 2.5 °F drop	**166.20** gpm		

pply Fan Sizing Data

ctual max CFM at Des Htg	**4290** CFM	Fan motor BHP	**1.87** BHP
tandard CFM	**4181** CFM	Fan motor kW	**1.40** kW
ctual max CFM/ft^2	**0.49** CFM/ft^2	Fan static	**1.50** in. wg.

tdoor Ventilation Air Data

esign airflow CFM	**1803** CFM	CFM/person	**15.54** CFM/person
FM/ft^2	**0.21** CFM/ft^2		